FLUKE®

Instruction Manual

Model

645A

Frequency Synthesizer

P/N 299073

REV. 3 12/72

SEPTEMBER 1970

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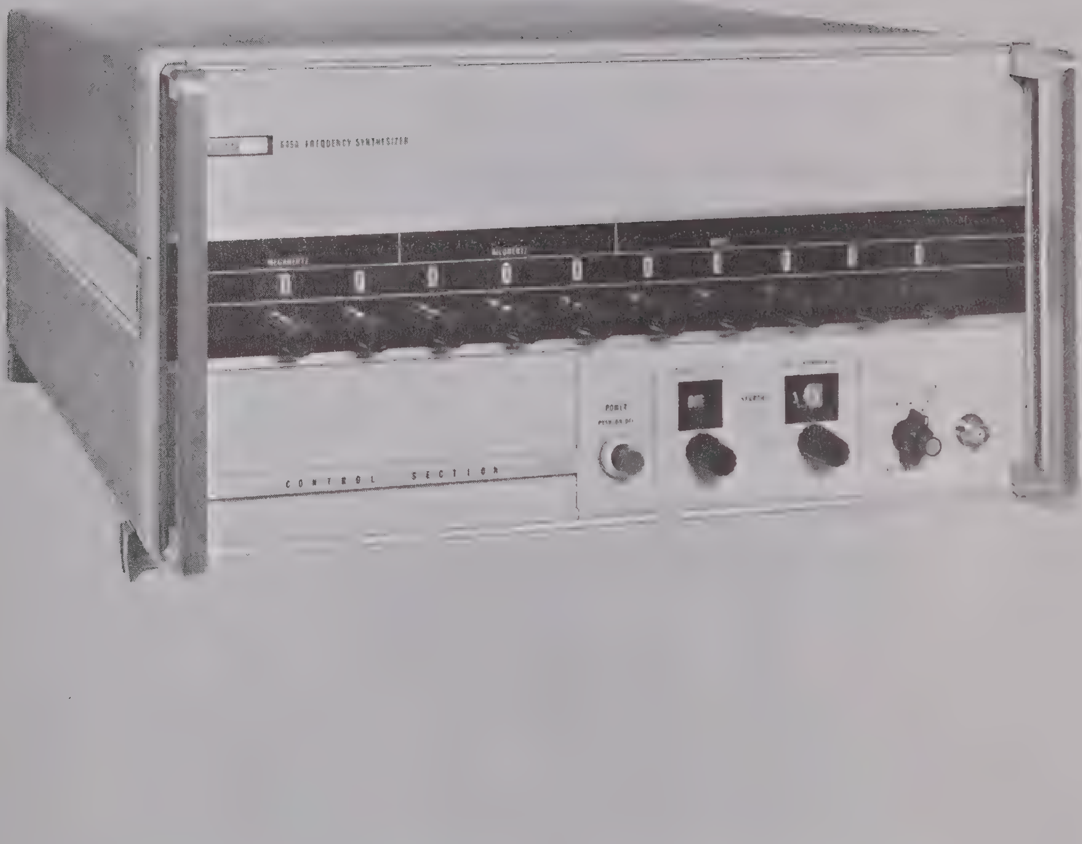

645A FREQUENCY SYNTHESIZER
MEGAHERTZ
KILOHERTZ
POWER
PUSH ON OFF
CONTROL SECTION

MODEL 645A FREQUENCY SYNTHESIZER

SECTION 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 645A Frequency Synthesizer produces output signals covering the frequency spectrum of 0 to 50 MHz. Two separate outputs, which are selectable in 0.01 Hz increments, are provided. One output is for frequencies from DC to 100 kHz, and the other is for frequencies from 50 Hz to 50 MHz. Two additional fixed outputs of 5 MHz and 10 MHz are also provided. All outputs are derived from a 5 MHz reference input through a direct process involving frequency multiplication, division, and translation. This direct frequency synthesizing technique produces coherent outputs which are related to the reference input by the ratio of two integers.

1-3. Output frequency selection can be accomplished from the front panel using decade dials or electrically through a remote connector on the rear panel. A total of 5 billion discrete frequencies are available for selection. Frequency switching times are less than 20 microseconds. A symmetrical search digit interpolator feature also allows continuous adjustment of the preselected output from 0 to ±100 kHz. This feature can be swept at 12 internal half-period rates from 10 milliseconds to 50 seconds. A sweep analog output voltage is available for synchronization of external display devices.

1-4. Amplitude control of the preselected output is possible using three different methods. The output can be preset to a fixed level, amplitude modulated, or adjusted to a desired level with an automatic level control. Fixed levels are maintained within ±1 db of their assigned level. Amplitude modulation (AM) is accomplished using an external modulation source. Maximum amplitude modulation capability is 50% at rates from DC to 10 kHz. The automatic level control (ALC) will maintain a 1.0 volt rms output level setting to within ±0.25 db. Frequency range of the ALC feature is 20 kHz to 50 MHz. This feature is designed for use with only the 50 Hz to 50 MHz output.

1-5. Systems capability is enhanced by local or remote control of most operating features. Local and remote control can be activated simultaneously or independently - as desired. Local control is accomplished directly from the front panel. Remote control is possible upon application of specific control signals to a Remote Input connector on the rear panel. Contact closures or equivalent between +12 volts dc and the appropriate control line is required for remote operation. Activation of the remote control modes is accomplished from the front panel. Remote frequency selection is by decimal logic - ten lines per decade. Search decade selection is also by decimal logic. If BCD programming is desired, an Accessory Model A607 BCD to Decimal Converter is available. This Accessory provides the required circuit interface and conversion to decimal logic. Logic input requirements for the Model A607 are as follows:

Logic "0" . . .	Input of 0 to 0.8 vdc at a maximum current of –4 ma.
Logic "1" . . .	Input of 2 to 5 vdc at a maximum input current of 1 ma.

1-6. The synthesizer is completely solid-state in design and modular construction is used throughout for ease in maintenance. Each printed circuit assembly located in the synthesizing process is enclosed in an rf-tight metal enclosure to minimize contaminates in the output. The chassis is designed for bench-top use or installation in a standard 19 inch electronic equipment rack. Chassis slides and mounting brackets are included for rack installation. Input power requirement is compatible with all domestic and foreign primary voltages.

1-7. Optional features are also available to meet specific synthesizer application requirements. Various options are shown in Table 1-1.

Table 1-1. OPTIONS

OPTION	DESCRIPTION
-11	Frequency Standard, ±1 part in 10^8 per day drift rate.
-12	Frequency Standard, ±2 parts in 10^9 per day drift rate.
-13	1 Hz resolution.
-14	0.1 Hz resolution.
-15	0.01 Hz resolution.
-16	Search and sweep functions.
-17	1 MHz to 5 MHz input Frequency Multiplier
-18	Rack Mounting Kit.
Accessories	**Description**
A 607	BCD to decimal interface

1-8. SPECIFICATIONS

Frequency

RANGE	DC to 50 MHz.
INCREMENTS	0.01 Hz.
SELECTION	Front panel rotary switches or by remote contact closures.

Spurious Outputs

NON-HARMONIC	Greater than 100 db below the fundamental.
HARMONICS	Greater than 30 db below the fundamental.

Signal To Noise Ratio

INCLUDING THE EFFECTS OF THE INTERNAL STANDARD:		
PHASE	Greater than 66 db	Measured in a 30 kHz band, excluding a 1 Hz band centered on the fundamental. Valid for dialed frequencies from 1 MHz to 50 MHz.
AMPLITUDE	Greater than 86 db	
SYNTHESIZER RESIDUAL (Internal noise from 5 MHz input to synthesizer output)		
PHASE	Greater than 78 db	
AMPLITUDE	Greater than 88 db	

RESIDUAL PHASE NOISE SPECTRAL DENSITY	SSB S/N ratio from 5 MHz input to synthesizer output; measured in a 1 Hz bandwidth. Valid for dialed frequencies from 1 MHz to 50 MHz.

OFFSET FREQUENCY	MINIMUM S/N
20 Hz	104.6 db
200 Hz	116.6 db
5 kHz	129.9 db
50 kHz	132.0 db

Output Voltage	
50 Hz - 50 MHz	Adjustable from 0.2 to 1.0 volts rms into 50 ohms with Auto-Level-Control (ALC) by front panel control or external DC voltage. ALC level maintained from 20 kHz to 50 MHz at 1.0 volt rms, ±0.25 db into 50 ohms, 25°C ambient. 1.0 volt rms, ±1 db into 50 ohms. (ALC disabled) Spectral specifications are valid at 1.0 volt rms into 50 ohms with or without ALC.
0 - 100 kHz	100 millivolts rms, ±2 db into 50 ohms.
AMPLITUDE MODULATION	Both outputs capable of external modulation to 50% at rates from DC to 10 kHz.
Switching Time	Less than 20 microseconds for output amplitude to be within ±1 db of final value, and phase to be within ±0.1 radian at its new frequency (without ALC).
Search Digit Interpolator	
SEARCH OSCILLATOR	Continuous adjustment about the selected synthesizer output with a range of ±0.01 Hz to ±100 kHz. Selectable in decade steps by front panel or remote contact closures.
LOCAL SEARCH	Calibrated by front panel control.
REMOTE SEARCH	Programmable by external resistance or voltage of –10 to +10 vdc.
ACCURACY	±2% of range at 25°C; ±5% of range at 0 to 55°C.
FREQUENCY MODULATION	May be modulated up to a 1 kHz rate.
INTERNAL SWEEP GENERATOR	Internal triangular waveform with nominal half-periods of 10 milliseconds to 50 seconds in 1, 2, 5 sequences. Sweep width selectable to nominally 100%, 50%, and 20% of search decade. Sweep analog waveform available at rear panel connector.
Internal Frequency Standard	
FREQUENCY	5 MHz.
AGING RATE	±2 parts in 10^9 per 24 hours. (Optional) ±1 part in 10^8 per 24 hours. (Standard)
Auxiliary Outputs	5 MHz and 10 MHz at nominally 1.0 volt rms into 50 ohms.
Auxiliary Inputs	External 5 MHz frequency standard. External ALC control voltage.
Power Requirements	100/115/200/230 volts rms, ±10%; selectable by rear panel switch. 50 Hz to 400 Hz; 125 watts maximum.

Environmental

OPERATING	0 to 55°C. 0 to 85% R.H. 0 to 10,000 feet.
NON-OPERATING	–62°C to +75°C. 0 to 50,000 feet.

Options and Accessories . . . .

11	Frequency Standard, ±1 part in 10^8 per day drift rate
12	Frequency Standard, ±2 parts in 10^9 per day drift rate
13	1 Hz resolution
14	.1 Hz resolution
15	.01 resolution
16	Search and Sweep
17	1 MHz to 5 MHz input Frequency Multiplier
18	Rack Mounting Kit
A607	BCD to decimal interface (External package, 3½" rack height.) (Integrated circuit compatable.)

Size . . . . Standard 19 inch (48.3 cm) relay rack width, 8¾ inches (22.2 cm) high, 23-5/8 inches (60.0 cm) behind front panel. Rack mounting kit provided.

Weight . . . . 90 pounds (41 Kg).

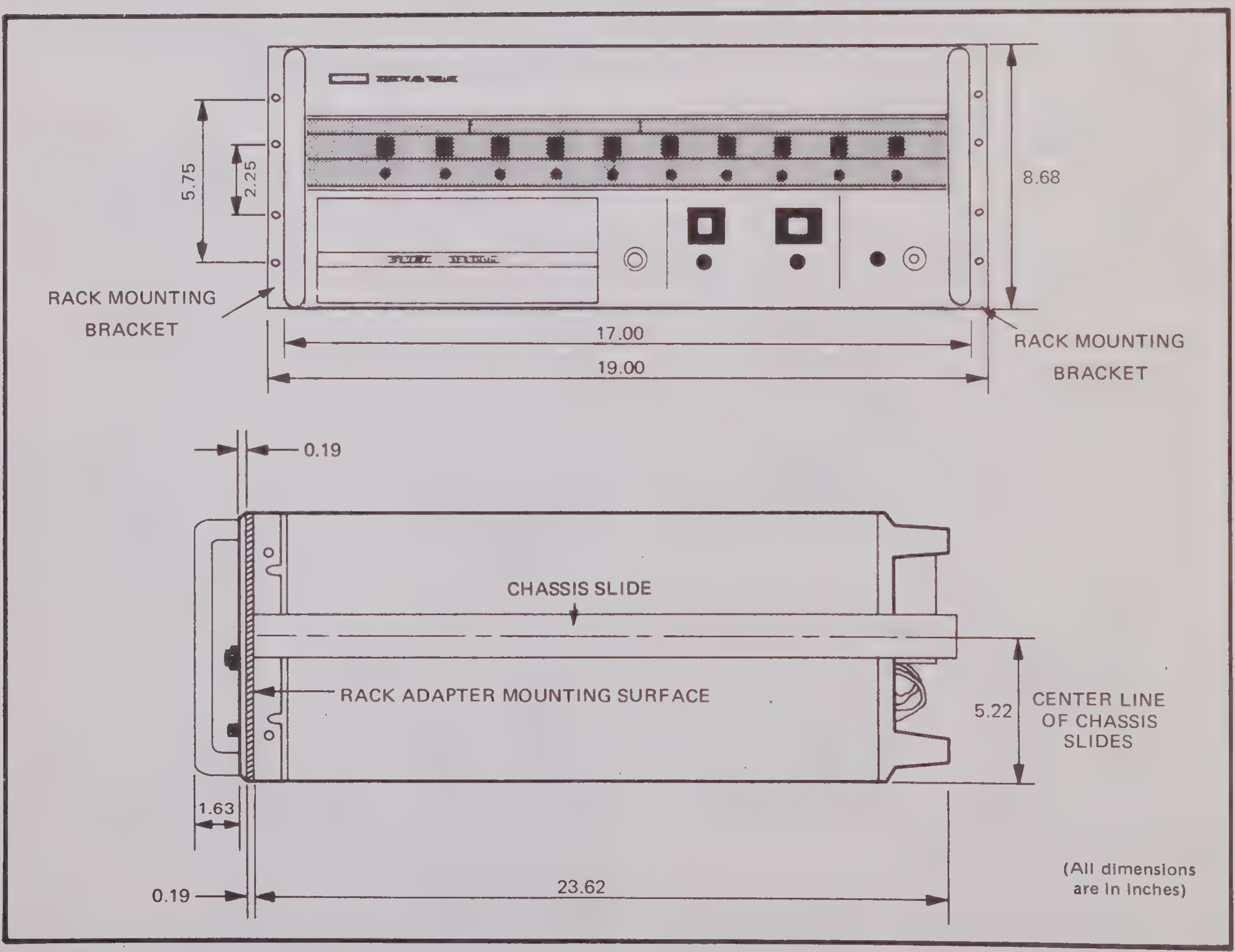
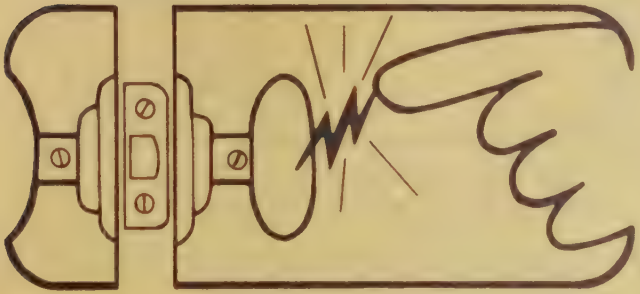

5.75
2.25
8.68
RACK MOUNTING BRACKET
17.00
19.00
RACK MOUNTING BRACKET
0.19
CHASSIS SLIDE
RACK ADAPTER MOUNTING SURFACE
5.22
CENTER LINE OF CHASSIS SLIDES
1.63
0.19
23.62
(All dimensions are in inches)

Figure 1-1. OUTLINE DRAWING

static awareness

A Message From

John Fluke Mfg. Co., Inc.

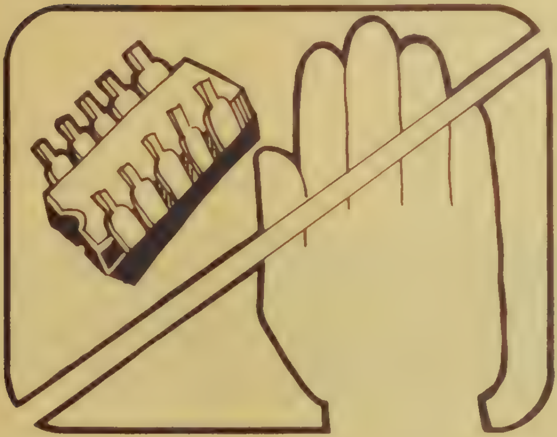


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

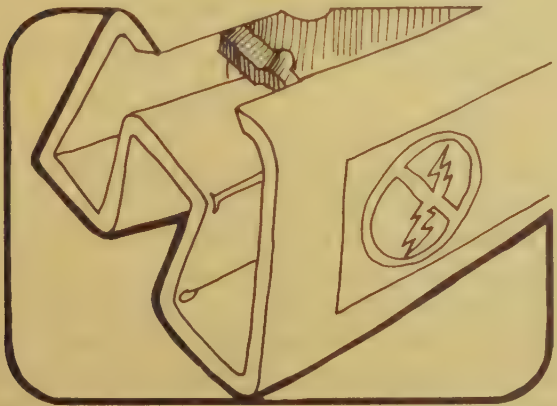
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol " ⊗ ".

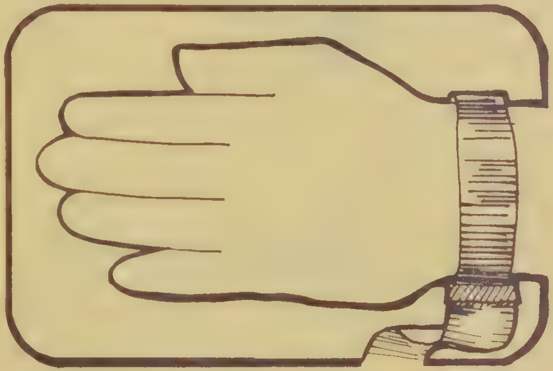
The following practices should be followed to minimize damage to S.S. devices.



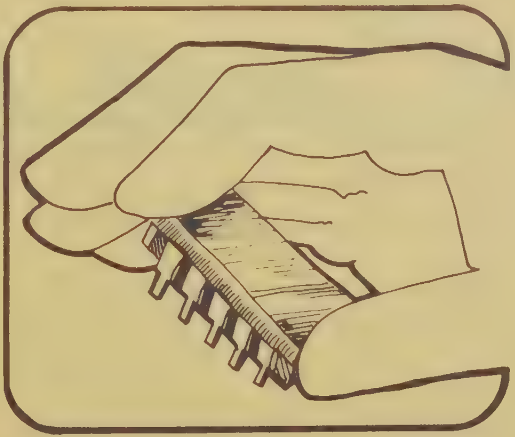
1. MINIMIZE HANDLING



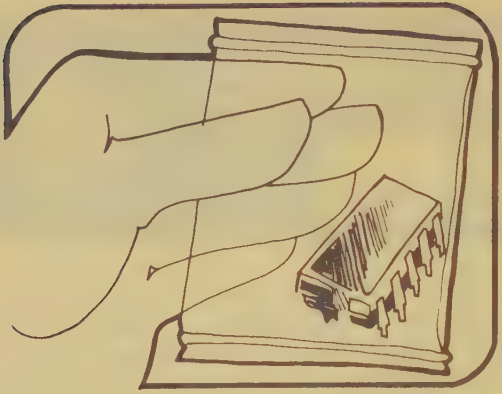
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



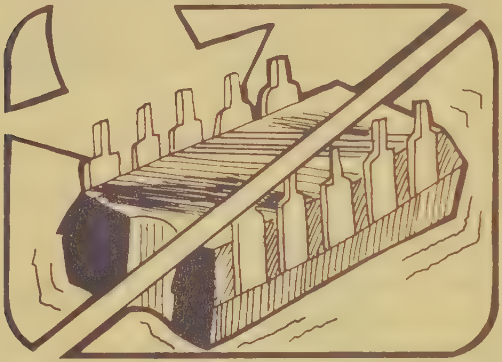
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



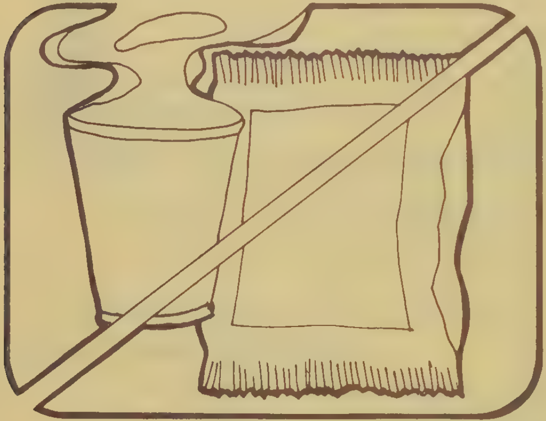
4. HANDLE S.S. DEVICES BY THE BODY



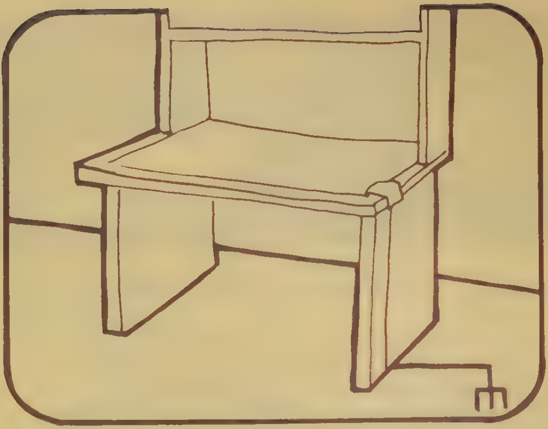
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

SECTION 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information necessary for the correct operation of the Model 645A Frequency Synthesizer. It is recommended that the contents of this section be thoroughly read and understood before attempting to operate the synthesizer. Should any difficulties be encountered during the operation of the synthesizer, feel free to contact the nearest John Fluke Sales Representative of the John Fluke Mfg. Co., Inc., P.O. Box 7428, Seattle, Washington. A complete list of Sales Representatives is located at the rear of this manual.

2-3. INPUT POWER

2-4. The Model 645A can be operated from a 50 to 400 Hz, 100, 115, 200, or 230 volt ac power source. A LINE VOLTAGE switch located on the synthesizer rear panel will provide rapid conversion to any of these four power line voltages. One ampere SLO-BLO fuses are initially installed in the synthesizer at the factory and are of adequate rating for operation from 100 or 115 volt ac power lines. If the synthesizer is to be operated from a 200 or 230 volt ac power line, replace these fuses with ½ ampere SLO-BLO fuses.

2-5. RACK INSTALLATION PROCEDURES

2-6. The Model 645A is designed for bench-top use or for installation in a standard 19 inch electronic equipment rack. Resilient feet have been installed on the bottom of the synthesizer to allow bench-top use. Chassis slides, spacers, and rack mounting brackets are furnished to facilitate installation in an electronic equipment rack. Figure 2-1 shows the locations of the rack mounting components.

2-7. If the synthesizer is to be installed in an electronic equipment rack, the chassis slides and rack mounting brackets can be installed by performing the following steps:

a. Peel the decals from the front side panels of the synthesizer and install the rack mounting brackets.

b. Slide the plastic side strips from the middle side panels of the synthesizer and install the slide spacers and chassis slides.

c. Remove the resilient feet from the bottom of the synthesizer and install the synthesizer in the electronic equipment rack.

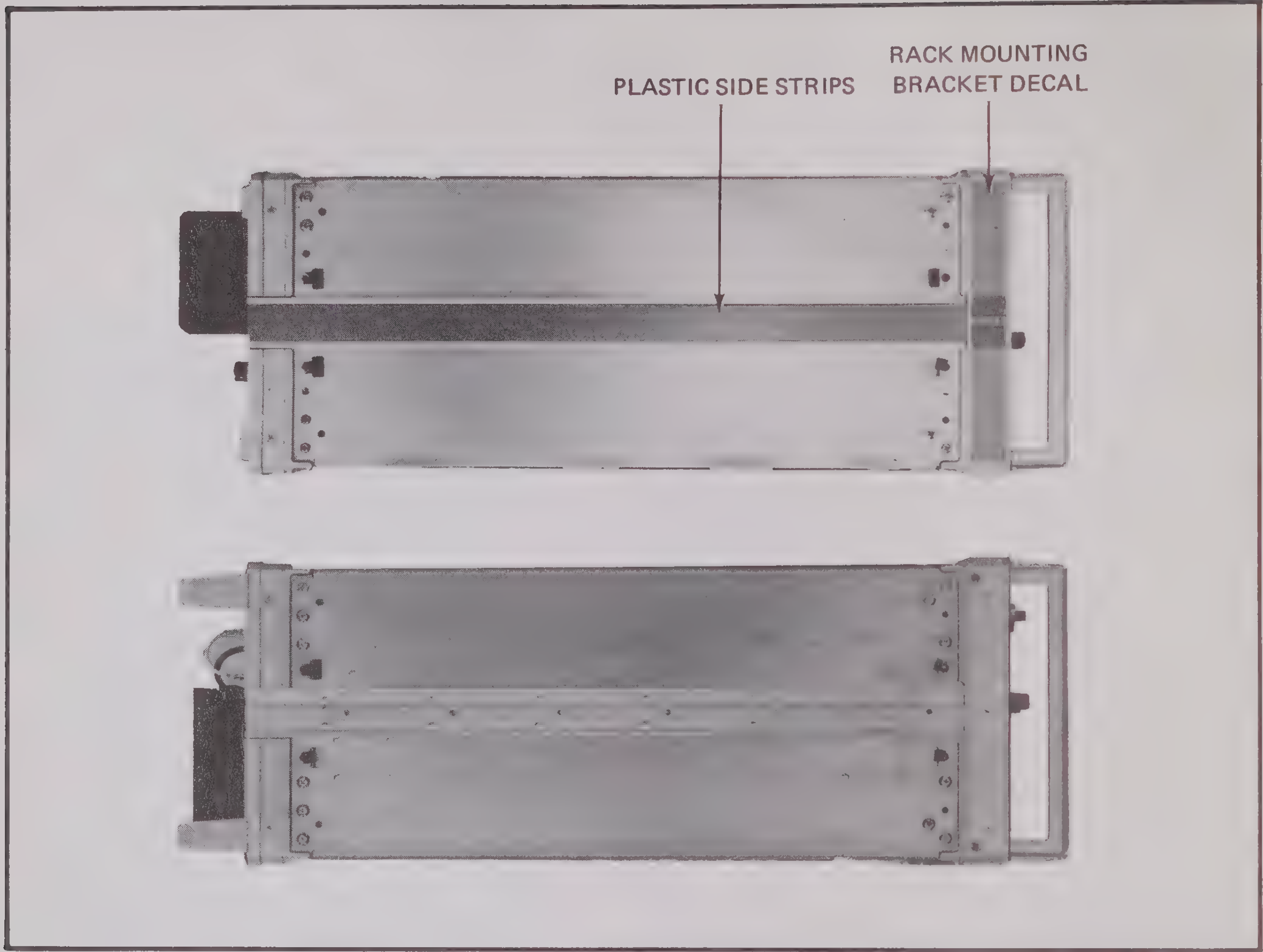


Figure 2-1. RACK INSTALLATION COMPONENT LOCATIONS

d. Place the LINE VOLTAGE switch to the position that corresponds to the available line power voltage. Refer to the preceding INPUT POWER paragraphs for correct fuse ratings.

e. Connect the synthesizer power cable to the available line power receptacle.

CAUTION!

Ensure that the round pin on the three-prong line power cable is connected to a high quality earth ground.

f. Make the required cable connections on the rear panel of the synthesizer. Cable connections are given in paragraph 2-10.

2-8. OPERATING FEATURES

2-9. Location and function of all controls, indicators, and input-output connectors are contained in Figure 2-2.

2-10. INITIAL OPERATING PROCEDURES

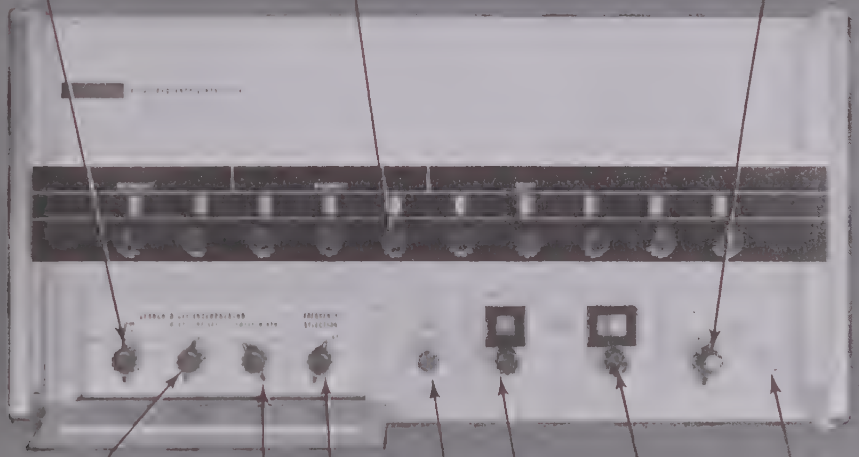
2-11. Before attempting to operate the synthesizer, perform the following cable connections and control settings:

a. Place the rear panel LINE VOLTAGE switch to a position that corresponds to the power line voltage and then connect the synthesizer power cable to the power line receptacle. The power supply and internal frequency standard are operating whenever ac power is applied to the synthesizer.

CAUTION!

Ensure that the round pin on the three-prong power cable plug is connected to a high quality earth ground.

b. Apply a 5 MHz frequency standard drive signal, which has a level of 1.0 volt rms, ±3 db, to the rear panel SYNTHESIZER INPUT connector. This



FREQUENCY DIALS (10 places)

In-line digit switches that provide selection of the synthesizer output frequency. Full 360° rotation is available on the 0.01 through 1 MHz dials.

SEARCH DIGIT INTERPOLATOR MODE

Selects the LOCAL, REMOTE or SWEEP deviation of the SEARCH mode.

LOCAL – The SEARCH deviation is controlled by the DIGIT INTERPOLATOR Dial.

REMOTE – The SEARCH deviation is controlled by the dc voltage applied to the rear panel REMOTE SEARCH INPUT connector.

SWEEP – The SEARCH mode is swept at a rate and magnitude selected by the SWEEP TIME-SEC and SWEEP WIDTH controls.

SWEEP TIME-SEC

Selects the desired 0.01 through 50 second half range sweep time.

SWEEP WIDTH

Selects the desired X1, X.5, or X.2 sweep range. The X1 position is proportional to a full decade digit variation.

FREQUENCY SELECTION

Selects LOCAL or REMOTE control of the synthesizer output frequency.

LOCAL – Selection of the synthesizer output frequency is provided with the front panel Frequency Dials.

REMOTE – Selection of the synthesizer output frequency is accomplished with dc control voltages applied to the rear panel Remote connector.

OUTPUT Selector

Selects the desired amplitude characteristic of the 0 - 100 kHz and 50 Hz - 50 MHz synthesizer outputs.

EXT AM – The amplitude of the 0 - 100 kHz and 50 Hz - 50 MHz outputs are determined by the signal applied to the rear panel EXTERNAL MODULATION INPUT connector.

1V RMS – The 0 - 100 kHz and 50 Hz - 50 MHz output signals are preset to respective levels of 0.1 and 1.0 volts rms, ±1 db, into 50-ohms.

ALC – The amplitude of the 50 Hz - 50 MHz output signal is adjustable from 0.2 to 1.0 volt rms into 50-ohms with the red ALC LEVEL control. An output setting of 1.0 volt rms into 50-ohms from 20 kHz to 50 MHz will be maintained within ±0.25 db by this ALC feature.

OUTPUT CONNECTOR

Provides a convenient front panel output for connection to one of four rear panel output signals.

DIGIT INTERPOLATOR Dial

Whenever the DECADE SELECTOR is placed to the .01 through 100K position, this dial provides continuous adjustment above or below the digit of the selected frequency decade.

DECADE SELECTOR

Selects the desired .01 through 100K SEARCH decade. Visual indication of the selected frequency decade is provided by illumination of the Frequency Dial indicator lamp.

POWER SWITCH

Pushbutton switch used to energize the synthesizer circuitry. Illumination of this switch indicates the synthesizer is fully operational. When line power is applied to the synthesizer, the internal standard and power supply are operating.

Figure 2-2. OPERATING FEATURES (Sheet 1 of 2)

MODULATION/ALC

ALC LEVEL OUTPUT — A dc voltage proportional to the setting of the front panel ALC LEVEL control is available at this connector for application to the MANUAL CONTROL INPUT. A patch cable supplied in the Accessory Kit will provide the appropriate circuit connection.

ALC LEVEL INPUT — Receives either the MANUAL CONTROL OUTPUT or dc voltage from an externally located source.

ALC DET OUTPUT — The internal AGC detector signal used with the ALC function is available at this connector for application to the AGC INPUT. A patch cable supplied in the Accessory Kit will provide the appropriate circuit connection.

ALC INPUT — Receives either the AGC DETECTOR OUTPUT signal or an externally located detector signal required for the ALC function.

EXT AM — Receives an external modulation signal required for the EXT AM function.

INTERNAL STANDARD

5 MHz — The output of the internal frequency standard is available at this connector for use as a synthesizer drive source. A patch cable supplied in the Accessory Kit will provide the circuit connection.

AUXILIARY OUTPUTS

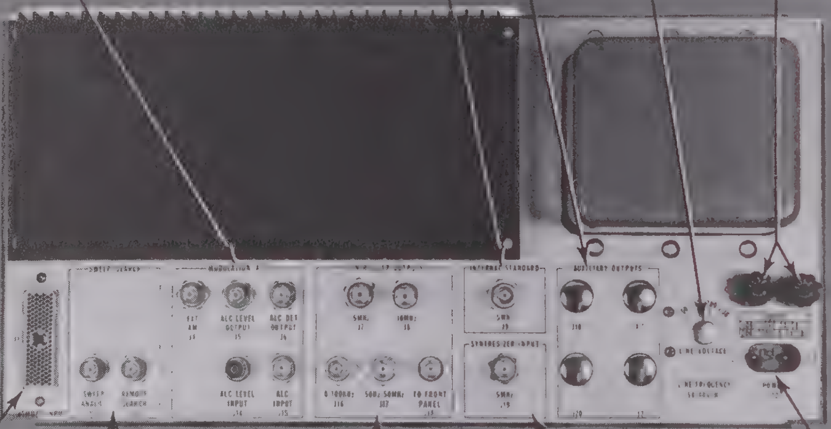
Outputs determined by specific synthesizer application requirements are provided in this area.

LINE VOLTAGE

A switch located behind the snap button allows rapid conversion to the appropriate line power voltage.

FUSES

Protect the input circuitry from overloads. For 100 or 115 VAC, use 1A, SLO-BLO. For 200 VAC, use ½A, SLO-BLO.



REMOTE INPUT

Receives remote control input signals. A mating connector is supplied in the accessory kit.

POWER RECEPTACLE

Receives input power through the ac power cord supplied with the synthesizer.

SYNTHESIZER INPUT

5 MHz — Receives the 5 MHz drive signal required to operate the synthesizer. This signal must have a level of 1v rms, ±3 db into 50-ohms.

SWEEP/SEARCH

SWEEP ANALOG — A sweep analog voltage proportional to the SEARCH deviation is available at this connector for synchronization of display devices.

REMOTE SEARCH — Receives a dc control voltage for remote operational of the SEARCH DIGIT INTERPOLATOR.

SYNTHESIZER OUTPUTS

5 AND 10 MHz — 5 and 10 MHz buffered outputs derived from synthesizer drive source are available at these connectors. Both outputs are preset to 1V rms, ±1 db into 50-ohms.

0 — 100 kHz — A low-level synthesized output, dependent on the settings of the front panel controls, is available at this connector.

50 Hz — 50 MHz — The synthesized output, dependent on the settings of the front panel controls, is available at this connector.

TO FRONT PANEL — This connector allows any of the desired rear panel outputs to be applied to the front panel OUTPUT connector. A patch cable supplied in the Accessory Kit will provide the appropriate circuit connection.

Figure 2-2. OPERATING FEATURES (Sheet 2 of 2)

drive signal can be obtained from the INTERNAL STANDARD connector or an external drive source. If an external drive source is used, care should be exercised in transmitting the drive signal to reduce the possibility of contaminating the signal with hum and noise.

NOTE!

The internal 5 MHz frequency standard must be operated for at least 72 hours before specified frequency stabilities are available.

c. Connect coaxial patch cables between the following rear panel connectors. Patch cables are contained in the Accessory Kit furnished with the synthesizer.

ALC DET OUTPUT . . .	ALC INPUT
ALC LEVEL OUTPUT . .	ALC LEVEL INPUT

d. Connect a 50-ohm load to each SYNTHESIZER OUTPUT connector.

e. Place the front panel controls to the following positions:

Frequency Dials	01000000.00
SEARCH DIGIT INTERPOLATOR MODE	LOCAL
SWEEP TIME-SEC	10
SWEEP WIDTH	x1
FREQUENCY SELECTION	LOCAL
DECADE SELECTOR	OFF
DIGIT INTERPOLATOR	
Dial	0
OUTPUT	
Outer Knob	1V RMS
Inner Knob	Fully CW

f. Press the POWER switch to fully energize the synthesizer. The POWER switch should illuminate.

2-12. OPERATIONAL TESTS

2-13. The following test can be used to initially verify operation of the synthesizer. The test equipment necessary to perform these tests is listed below:

Frequency Counter	HP 5245M
RF Voltmeter	HP 411A
RMS Voltmeter	JF 931B

a. Perform the operations contained in paragraph 2-10.

b. Connect the frequency counter and rf voltmeter inputs to the 50 Hz - 50 MHz SYNTHESIZER OUTPUT connector and the previously installed 50-ohm load.

NOTE!

The frequency counter must be gated with a frequency standard signal derived from the synthesizer drive source. If the frequency counter has either a 5 or 10 MHz external gating capability, the buffered 5 or 10 MHz output of the Model 645A can be used.

c. Observe that the SYNTHESIZER OUTPUT frequency is 1.0 MHz and has a level of 1.0 volt rms, ±1 db.

d. Rotate the Frequency Dials through the 50 Hz to 50 MHz frequency band, using repeating series of digits from 01111111.11 to 09999999.99. The frequency counter must indicate an output frequency which corresponds to each particular setting of the Frequency Dials. The rf voltmeter should indicate an output signal level of 1.0 volt rms, ±1 db, for each Frequency Dial setting.

e. Set the Frequency Dials to 00100000.00.

f. Place the OUTPUT control to ALC and slowly rotate the inner knob counter-clockwise, observing that the 50 Hz - 50 MHz SYNTHESIZER OUTPUT signal smoothly decreases to approximately 0.2 volts rms.

g. Place the OUTPUT control to 1V RMS and rotate the inner knob fully clockwise.

h. Place the DECADE SELECTOR to 100K and rotate the DIGIT INTERPOLATOR Dial to −1.0. A 100K indicator lamp above the 100 kHz Frequency Dial should be illuminated and the synthesizer output frequency should be 0 Hz, ±5 kHz.

i. Rotate the DIGIT INTERPOLATOR Dial to +1.0. The synthesizer output frequency should be 200 kHz, ±5 kHz. Set the DIGIT INTERPOLATOR Dial to 0 upon completion of this step.

j. Place the SEARCH DIGIT INTERPOLATOR MODE switch to the SWEEP position, observing that the synthesizer output frequency sweeps from 0 to 200 kHz in approximately 10 seconds.

k. Place the SWEEP WIDTH switch to the x.5 position, observing that the synthesizer output frequency sweeps from 50 to 150 kHz in approximately 10 seconds.

l. Place the SWEEP WIDTH switch to the x.2 position, observing that the synthesizer output frequency sweeps from 80 to 120 kHz in approximately 10 seconds.

m. Place the SWEEP WIDTH switch to the x1 position.

n. Place the DECADE SELECTOR to each available position (10k through .01), observing that the synthesizer output frequency sweeps plus and minus the DECADE SELECTOR indication in approximately 10 seconds.

o. Place the DECADE SELECTOR to OFF.

p. Connect the rms voltmeter input to the 0 - 100 kHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. The rms voltmeter should indicate an output signal level of 0.1 volts rms, ±20 mv.

q. Rotate the Frequency Dials through the 0 to 100 kHz frequency band, observing that the output signal level is 0.1 volts rms, ±20 mv.

r. Connect the frequency counter and rf voltmeter inputs to the 5 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. The output frequency should be 5 MHz and have a level of 1.0 volt rms, ±1 db.

s. Connect the frequency counter and rf voltmeter inputs to the 10 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. The output frequency should be 10 MHz and have a level of 1.0 volt rms, ±1 db.

2-14. When the results of these tests agree with the information given, the synthesizer is operating correctly and the test equipment can be disconnected.

2-15. OPERATING PROCEDURES

2-16. Variable Output Frequency

2-17. Selection of the 0 to 50 MHz variable output frequency can be accomplished from the synthesizer front panel or remotely with programming commands applied to the rear panel REMOTE connector. When the FREQUENCY SELECTION switch is placed to the LOCAL position, control of the synthesizer output frequency is accomplished using the front panel Frequency Dials. Setting this control to the REMOTE position disables the Frequency Dials and transfers control to the rear panel REMOTE connector. Remote control input requirements are given in paragraph 2-24.

2-18. Separate 0 to 100 kHz and 50 Hz to 50 MHz outputs are available at the rear panel of the synthesizer. When the OUTPUT control is set to 1V RMS, the 0 - 100 kHz output is preset to 0.1 volts rms, ±1 db into 50 ohms and the 50 Hz - 50 MHz output is preset to 1.0 volts rms, ±1 db into 50 ohms. Setting the OUTPUT control to the ALC position allows adjustment of the 50 Hz - 50 MHz output level from 0.2 to 1.0 volts rms with the inner knob of the OUTPUT control. This ALC feature will maintain the output level setting of 1.0 volt rms from 20 kHz to 50 MHz to within ±0.25 db. Setting the OUTPUT control to EXT MOD position allows the amplitude of the 0 - 100 kHz and 50 Hz - 50 MHz outputs to be controlled by an external modulation source. Maximum amplitude modulation is 50% at rates from dc to 10 kHz. A rear panel connector labeled EXT AM provides connection to the external modulation source. Input requirements from the external modulation source are given in Table 2-1. Remote selection of the EXT MOD, 1V RMS or ALC feature is also possible. Remote control input requirements are given in paragraph 2-24.

2-19. The capability of continuously adjusting the 0.01 through 100 kHz frequency decades above or below their specific digit value is provided on the Search Digit Interpolator mode of operation. The amount of frequency deviation can be manually adjusted or it can be swept at a predetermined interval, thus providing a conventional search or sweep mode of operation. A sweep voltage output is available at the rear panel SWEEP ANALOG connector for use in driving display devices in synchronism with the synthesizer sweep rate. Independent or simultaneous remote control of these functions is also possible. Remote control input requirements are given in paragraph 2-24.

2-20. Five controls activate and control the Search Digit Interpolator functions. The DECADE SELECTOR is used to select the frequency decade digit to be interpolated and the SEARCH DIGIT INTERPOLATOR MODE switch selects the LOCAL, REMOTE or SWEEP mode of operation. The amount of frequency deviation on the LOCAL mode is adjusted with the DIGIT INTERPOLATOR Dial. On the SWEEP mode, the SWEEP WIDTH control selects the maximum frequency deviation. The rate of sweep deviation is selected with the SWEEP TIME-SEC control.

2-21. The synthesizer output frequency can be determined on the LOCAL Search Digit Interpolator mode by adding the product of the DECADE SELECTOR and DIGIT INTERPOLATOR Dial settings to the Frequency Dial digit indications. Calculation of the total SWEEP mode deviation is accomplished by multiplying the DECADE SELECTOR and SWEEP WIDTH control settings.

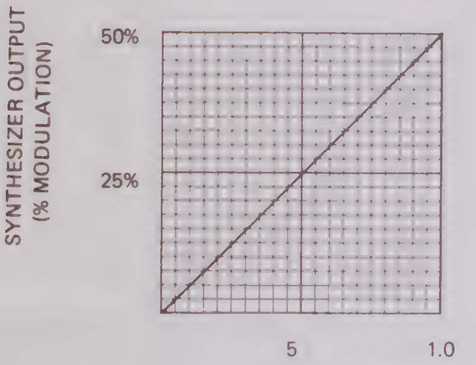
2-22. Fixed Output Frequencies

2-23. Two separate 5 and 10 MHz Fixed Output Frequencies are available at rear panel connectors labeled SYNTHESIZER OUTPUTS, 5 MHz, 10 MHz. Each output frequency is preset to a level of 1.0 volt rms, ±1 db, into 50 ohms.

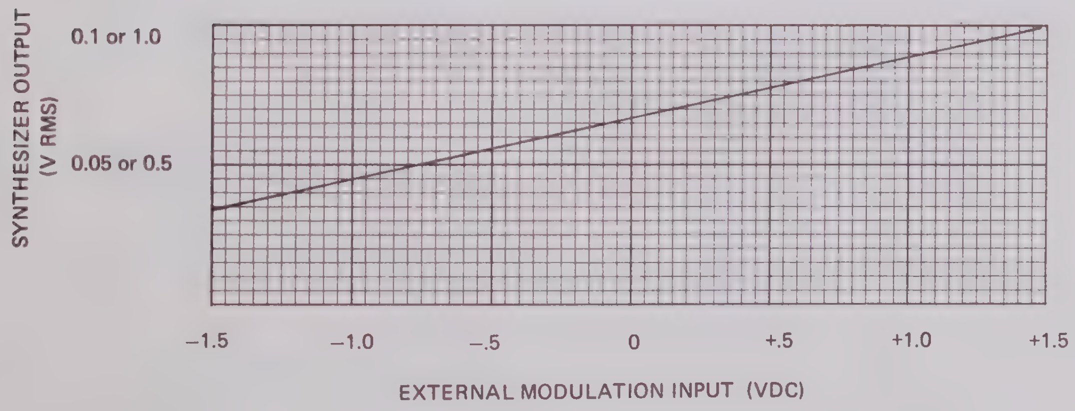
2-24. Remote Operation

2-25. Independent or simultaneous remote control of each synthesizer function is possible through the rear panel REMOTE INPUT connector. A mating connector and terminals are contained in the Accessory Kit furnished with the synthesizer. If BCD programming is desired, an Accessory Model A607 BCD to Decimal Converter will provide the necessary circuit interface and conversion. In-

Table 2-1. EXTERNAL MODULATION INPUT REQUIREMENTS.



NOTE: With no external modulation input applied, the synthesizer output is preset to 0.667 vrms.



formation regarding this Accessory is contained in Section VI.

2-26. Activation of the remote control features is accomplished by placing the FREQUENCY SELECTION, SEARCH DIGIT INTERPOLATOR MODE, and DECADE SELECTOR to their REMOTE positions and setting the OUTPUT control to 1V RMS. Suggested remote control wiring using contact closures is illustrated on the System DC Schematic, Drawing No. 645-1002. Diodes in series with the remote control switches provide isolation between the synthesizer and remote controls.

2-27. Remote selection and control of synthesizer output signal level is possible as long as the OUTPUT control is set to the 1V RMS position. Amplitude control of the 0 - 100 kHz and 50 Hz - 50 MHz outputs is possible on the EXT AM mode using an external control signal applied to the EXT AM connector. Input requirements for the external modulation source are given in Table 2-1. When the ALC feature is activated, the 50 Hz - 50 MHz output level is dependent upon the control signal applied to the ALC LEVEL INPUT connector. A nominal control voltage of +.59 to +3.24 volts dc at this connector will establish a corresponding 0.2 to 1.1 volt rms into 50 ohms output in the 20 kHz to 50 MHz range. Absence of both remote selection inputs will preset the 0 - 100 kHz and 50 Hz - 50 MHz outputs to respective levels of 0.1 and 1.0 volt rms into 50 ohms.

2-28. With suitable interface circuitry the synthesizer can be programmed using digital equipment. However, the electronic gates in the synthesizer present a load of 1.8k ohms to ground, which must be driven at a minimum voltage of 11 volts dc to energize the electronic gates and +0.3 volts dc or less to turn the electronic gates off. The circuitry illustrated in Figure 2-3 shows a suggested electronic gate driver. The diode CR2 provides isolation between the gate driver and the front panel controls. Inhibit commands are derived from the circuitry illustrated in Figure 2-4.

2-29. Inhibit commands for the remote digital programming circuitry are necessary to prevent interaction between the front panel and remote digital circuitry whenever the synthesizer is operated using the front panel controls. Frequency digit and search decade inhibit commands are available at terminals 121 and 125, respectively. However, these signals have to be inverted to drive the circuitry illustrated in Figure 2-3. The inverting circuitry of Figure 2-4 can be used to provide the required inhibit command.

2-30. Remote control of the SEARCH DIGIT INTERPOLATOR frequency is accomplished by applying a stable dc voltage of +10 to −10 volts dc to the REMOTE SEARCH connector. One volt dc from this source is equal to one major division of the DIGIT INTERPOLATOR Dial located on the front panel.

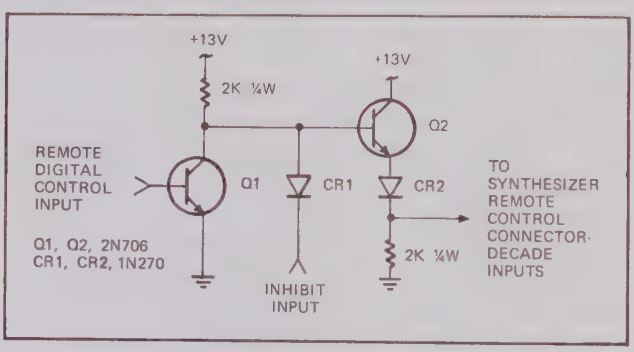

+13V
+13V
2K ¼W
Q2
REMOTE DIGITAL CONTROL INPUT
Q1
CR1
CR2
TO SYNTHESIZER REMOTE CONTROL CONNECTOR-DECADE INPUTS
Q1, Q2, 2N706
CR1, CR2, 1N270
2K ¼W
INHIBIT INPUT

Figure 2-3. REMOTE DIGITAL GATE DRIVER

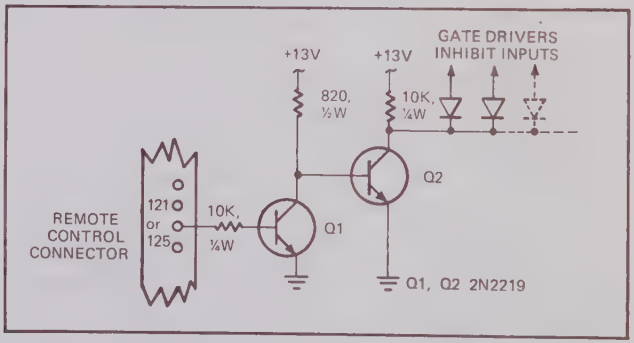


Figure 2-4. INHIBIT COMMAND INVERTER

SECTION 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains the theory of operation for the Model 645A Frequency Synthesizer. The information is arranged under headings of "Assembly Numbering System, Block Diagram Analysis, Basic Circuits, and Circuit Descriptions." Simplified block diagrams and circuits are shown in illustrations included with the text information. A functional block diagram and schematic diagrams are located at the rear of the manual.

3-3. ASSEMBLY NUMBERING SYSTEM

3-4. General

3-5. The following numbering system has been employed in the Model 645A to identify specific assemblies and their electrical components. Drawings associated with each assembly are identified by numbers numerically related to each particular assembly.

3-6. Assembly Reference Designations

3-7. The Model 645A is divided into six major assemblies designated the letter number A1 through A6. A list of these major assemblies and their respective titles is contained below:

A1	Final Assembly
A2	Front Panel
A3	Input Tray
A4	Subsynthesizer Tray
A5	UHF Tray
A6	Rear Panel

Subassemblies contained within the major assemblies are also identified by a letter number designation. For example, the 5 MHz Filter Amplifier module in the A3 Input Tray assembly has been assigned the letter number A7. If it then becomes necessary to completely identify this assembly, the assembly reference designation will be A3A7. Should it become necessary to identify a component on the A3A7, 5 MHz Filter Amplifier, the assembly reference designation could take the following form:

A3	A7	R1
Input Tray	5 MHz Filter Assembly	Resistor, 51Ω ±5%, ¼w

3-8. Assembly Identifiers

3-9. During the manufacturing process, assembly identifier numbers have been assigned to completed portions of the assemblies in the synthesizer. A description of these assembly identifiers are listed below:

a. A printed circuit board having no electrical components is identified by a 645-3000 series number silkscreened on the printed circuit board.

b. A completely assembled printed circuit assembly is identified by a 645-4000 series number that does not normally appear on the assembly.

c. A completely assembled module, which consists of a metal enclosure and the printed circuit assembly, is identified by a 645-4100 series number. This number appears on the metal enclosure decal.

3-10. Schematic Diagram Identifiers

3-11. The schematic diagrams and module assembly identifiers are numerically related for ease in identification. The schematic diagrams are identified by a 645-1100 series number contained in their title block, which corresponds to the module assembly 645-4100 series number. For example, the 645-4101, 5 MHz Filter Amplifier schematic diagram is identified by the number 645-1101.

3-12. BLOCK DIAGRAM ANALYSIS

3-13. The Model 645A Frequency Synthesizer generates large numbers of discrete stable frequencies derived from a 5 MHz reference drive source. Direct frequency synthesis involving frequency multiplication, addition, subtraction and division is employed to obtain an extremely pure output signal containing minimal noise contaminates. Additional benefits realized from direct frequency synthesis are switching times of less than 20 microseconds and 0.01 Hz resolution.

3-14. Circuit operation of the synthesizer will be discussed using the System Block Diagram, Drawing No. 645-1500 and simplified block diagrams contained in Figures 3-1 through 3-7. The Input and Subsynthesizer sections of the synthesizer will be discussed first and will cover attainment of the signals applied to the UHF Section. The UHF Section will be discussed next and will cover attainment of the preselected output signal. Discussions which describe the fixed outputs, search digit interpolator, and available options are then used to completely describe the operating characteristics of the synthesizer.

3-15. Input and Subsynthesizer Section (Figures 3-1 thru 3-3)

3-16. FIRST AND SECOND ORDER SYNTHESIS. Frequencies of 3, 4, 5, 10, 35, and 40 MHz, two groups of frequencies from 30 to 39 MHz, and a group of frequencies from 30 to 70 MHz are produced in the First and Second Order Synthesis circuitry. The 30 to 30 MHz signals consist of a Comb of frequencies available in 1 MHz increments, and the 30 to 70 MHz signals consist of a Comb of frequencies available in 10 MHz increments. These frequencies are distributed throughout the synthesizer for use in obtaining the preselected output frequency, fixed outputs, and search digit interpolator function.

3-17. A 5 MHz reference input signal, from either an external or the internal standard, is multiplied in the (A7) 5 MHz Filter Amplifier module to produce the initial synthesizing frequency of 10 MHz. The (A8) Spectrum Generator module receives the 10 MHz signal and produces output frequencies of 10, 30, 40, 50, 60 and 70 MHz. These signals, except for the 10 MHz signal, are applied to respective inputs of the (A2) through (A6) Harmonic Selector modules. Each of the Harmonic Selector modules contains an rf gate which passes the desired 30 through 70 MHz signal to the UHF Section on corresponding 4 through 0 commands from the 10 MHz frequency decade. Buffered outputs from the (A5) and (A6) modules are applied to the (A9) and (A10) 10:1 Divider modules, which produce 3, 4, 30, and 40 MHz signals used in the Subsynthesizer Section. The (A2) 70 MHz Harmonic Selector module also produces a 35 MHz output signal.

3-18. The 3, 4, 30, and 40 MHz signals are then applied in various combinations to the (A1) through (A8) Mixer modules to produce the 31 to 34 MHz and 36 to 39 MHz portions of the 30 to 39 MHz Comb. The 30 and 35 MHz portions of this Comb are derived directly from the (A10) 10:1 Divider and (A2) Harmonic Selector modules. The (A10) through (A14) Filter modules process the 30 to 39 MHz Comb freqeuncies and apply the signals to the (A9) 30 - 39 MHz Gate and (A15) Gate Matrix modules. The (A9) 30 - 39 MHz Gate module passes the desired 30 to 39 MHz Comb frequency to the UHF Section on corresponding 0 through 9 commands from the 1 MHz frequency decade. The (A15) Gate Matrix module passes the desired 30 to 39 MHz Comb frequencies to the Third Order Synthesis circuitry on commands from the 0.01 Hz through 100 kHz frequency decades.

3-19. THIRD ORDER SYNTHESIS. Construction of the Third Order Synthesis is accomplished through a series of arithmetic operations controlled by the settings of the eight lower order frequency dials. For explanation purposes in the following paragraphs, assume that a frequency dial setting of 38765432.10 Hz is established.

3-20. The .01 Hz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "a" Gate. With a .X0 Hz command present, a 30 MHz signal is passed through the "a" Gate and applied to the (A36) Digit Shift module, where it is divided down to 3.0 MHz by a 10:1 divider. The (A15) "A" Gate supplies a 33 MHz signal to the (A36) Digit Shift module where it is combined in an additive mixer with a 4.0 MHz signal derived from the (A9) 40 MHz 10:1 Divider module. The resulting 37 MHz signal is then combined in a second additive mixer with the 3.0 MHz signal derived from the (A15) "a" Gate, thus yielding a 40.0 MHz signal. This signal is divided down to 4.00 MHz with a 10:1 divider and applied to the (A35) Digit Shift module.

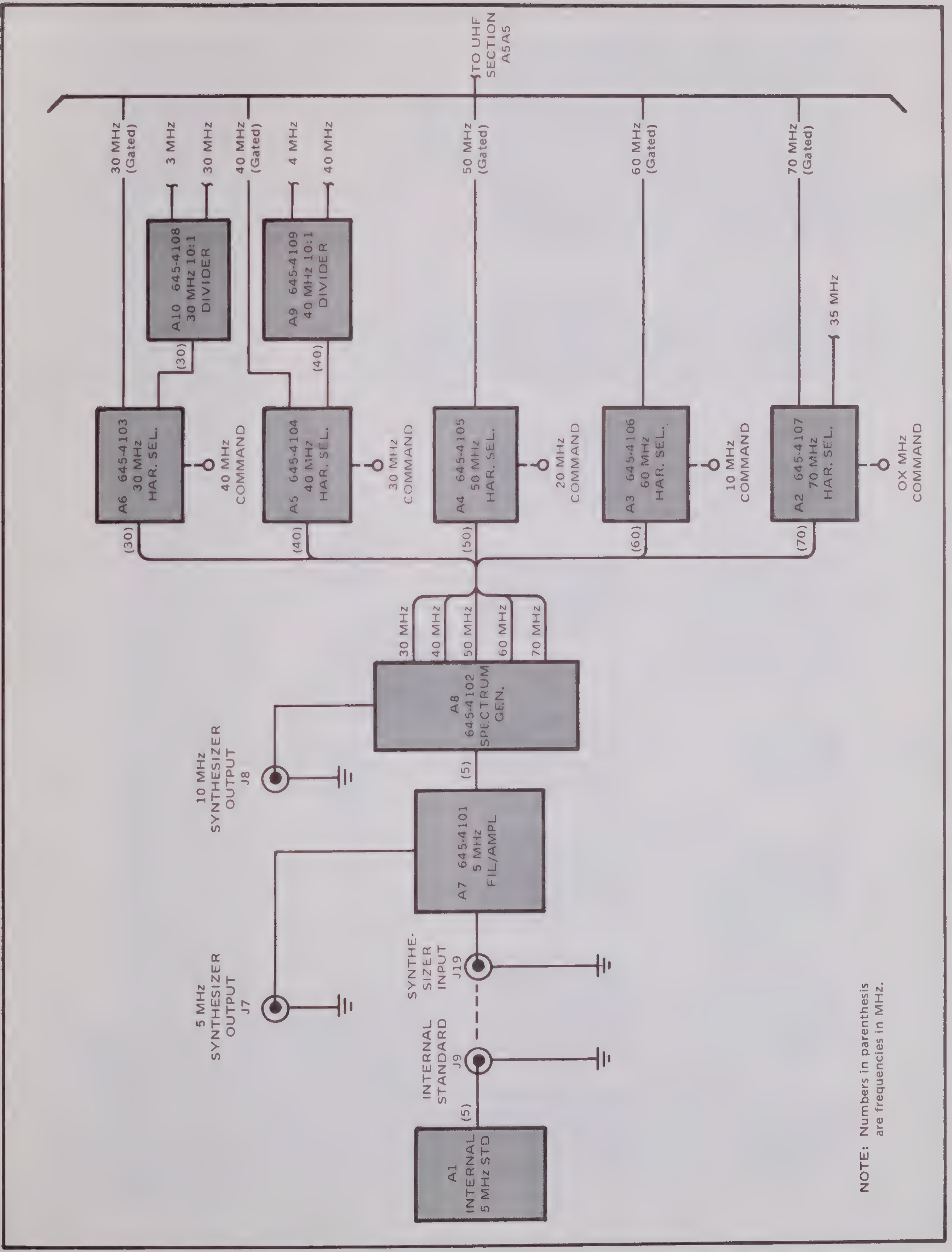

TO UHF SECTION A5A5
30 MHz (Gated)
3 MHz
30 MHz
40 MHz (Gated)
4 MHz
40 MHz
50 MHz (Gated)
60 MHz (Gated)
70 MHz (Gated)
A10 645-4108 30 MHz 10:1 DIVIDER
A9 645-4109 40 MHz 10:1 DIVIDER
35 MHz
(30)
(40)
A6 645-4103 30 MHz HAR. SEL.
A5 645-4104 40 MHz HAR. SEL.
A4 645-4105 50 MHz HAR. SEL.
A3 645-4106 60 MHz HAR. SEL.
A2 645-4107 70 MHz HAR. SEL.
40 MHz COMMAND
30 MHz COMMAND
20 MHz COMMAND
10 MHz COMMAND
OX MHz COMMAND
(30)
(40)
(50)
(60)
(70)
30 MHz
40 MHz
50 MHz
60 MHz
70 MHz
A8 645-4102 SPECTRUM GEN.
10 MHz SYNTHESIZER OUTPUT J8
(5)
A7 645-4101 5 MHz FIL/AMPL
5 MHz SYNTHESIZER OUTPUT J7
SYNTHE-SIZER INPUT J19
INTERNAL STANDARD J9
(5)
A1 INTERNAL 5 MHz STD
NOTE: Numbers in parenthesis are frequencies in MHz.

Figure 3-1. FIRST ORDER SYNTHESIS CIRCUITRY

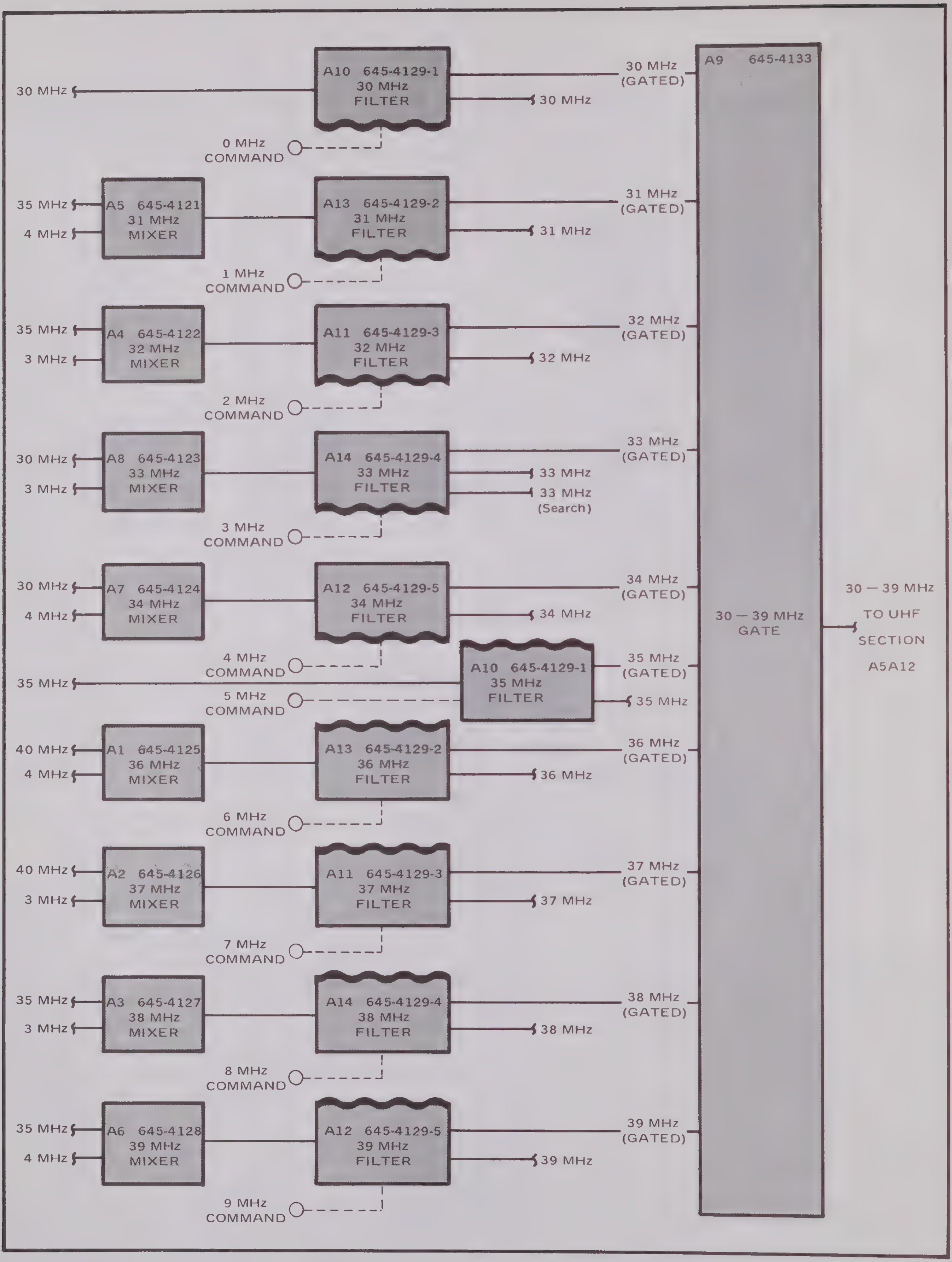
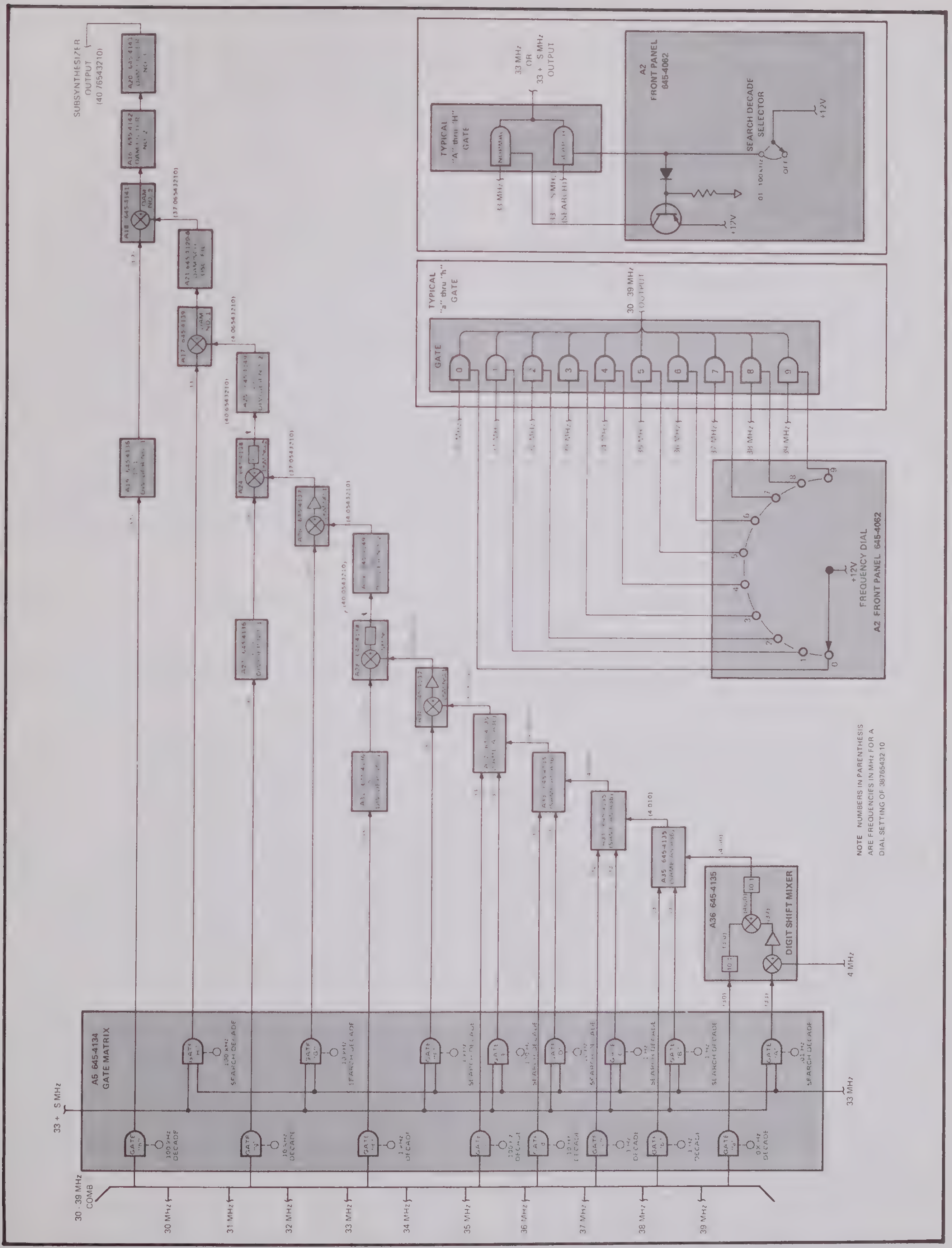

A10 645-4129-1
30 MHz
FILTER
30 MHz
30 MHz (GATED)
30 MHz
0 MHz COMMAND
A5 645-4121
31 MHz
MIXER
35 MHz
4 MHz
A13 645-4129-2
31 MHz
FILTER
31 MHz (GATED)
31 MHz
1 MHz COMMAND
A4 645-4122
32 MHz
MIXER
35 MHz
3 MHz
A11 645-4129-3
32 MHz
FILTER
32 MHz (GATED)
32 MHz
2 MHz COMMAND
A8 645-4123
33 MHz
MIXER
30 MHz
3 MHz
A14 645-4129-4
33 MHz
FILTER
33 MHz (GATED)
33 MHz
33 MHz (Search)
3 MHz COMMAND
A7 645-4124
34 MHz
MIXER
30 MHz
4 MHz
A12 645-4129-5
34 MHz
FILTER
34 MHz (GATED)
34 MHz
4 MHz COMMAND
35 MHz
5 MHz COMMAND
A10 645-4129-1
35 MHz
FILTER
35 MHz (GATED)
35 MHz
A1 645-4125
36 MHz
MIXER
40 MHz
4 MHz
A13 645-4129-2
36 MHz
FILTER
36 MHz (GATED)
36 MHz
6 MHz COMMAND
A2 645-4126
37 MHz
MIXER
40 MHz
3 MHz
A11 645-4129-3
37 MHz
FILTER
37 MHz (GATED)
37 MHz
7 MHz COMMAND
A3 645-4127
38 MHz
MIXER
35 MHz
3 MHz
A14 645-4129-4
38 MHz
FILTER
38 MHz (GATED)
38 MHz
8 MHz COMMAND
A6 645-4128
39 MHz
MIXER
35 MHz
4 MHz
A12 645-4129-5
39 MHz
FILTER
39 MHz (GATED)
39 MHz
9 MHz COMMAND
A9 645-4133
30 — 39 MHz GATE
30 — 39 MHz TO UHF SECTION A5A12

Figure 3-2. SECOND ORDER SYNTHESIS CIRCUITRY


SUBSYNTHESIZER OUTPUT (40.76543210)
A20 645-4143 DAM FILTER NO. 1
A16 645-4142 DAM FILTER NO. 2
A18 645-4141 DAM NO. 2
A21 645-4140 DAM FILTER
A17 645-4139 DAM NO. 1
A35 645-4135
A36 645-4135
DIGIT SHIFT MIXER
4 MHz
A5 645-4134
GATE MATRIX
33 + .5 MHz
33 MHz
30 - 39 MHz COMB
30 MHz
31 MHz
32 MHz
33 MHz
34 MHz
35 MHz
36 MHz
37 MHz
38 MHz
39 MHz
TYPICAL "a" thru "h" GATE
30 - 39 MHz OUTPUT
GATE
0
1
2
3
4
5
6
7
8
9
+12V
FREQUENCY DIAL
A2 FRONT PANEL 645-4062
TYPICAL "A" thru "H" GATE
33 MHz OR 33 + .5 MHz OUTPUT
NORMAL
33 MHz
33 + .5 MHz (SEARCH)
A2
FRONT PANEL
645-4062
SEARCH DECADE SELECTOR
.01 - 100 kHz
OFF
+12V

NOTE: NUMBERS IN PARENTHESIS ARE FREQUENCIES IN MHz FOR A DIAL SETTING OF 38765432.10

Figure 3-3. THIRD ORDER SYNTHESIS CIRCUITRY

3-21. The .1 Hz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "b" Gate. With a .1 Hz command present, a 31 MHz signal is passed through the "b" Gate and applied to the (A35) Digit Shift module, where it is divided down to 3.1 MHz by a 10:1 divider. The (A15) "B" Gate supplies a 33 MHz signal to the (A35) Digit Shift −2 module where it is combined in an additive mixer with the 4.00 MHz output of the (A36) Digit Shift −1 module. The resulting 37.00 MHz signal is then combined in a second additive mixer with the 3.1 MHz signal derived from the (A15) "b" Gate, thus yielding a 40.10 MHz signal. This signal is divided down to 4.010 MHz by a 10:1 divider and applied to the (A34) Digit Shift module.

3-22. The 1 Hz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "c" Gate. With a 2 Hz command present, a 32 MHz signal is passed through the "c" Gate and applied to the (A34) Digit Shift module, where it is divided down to 3.2 MHz by a 10:1 divider. The (A15) "C" Gate supplies a 33 MHz signal to the (A34) Digit Shift module where it is combined in an additive mixer with the 4.010 MHz output of the (A35) Digit Shift module. The resulting 37.010 MHz signal is then combined in a second additive mixer with the 3.2 MHz signal derived from the (A15) "c" Gate, thus yielding a 40.210 MHz signal. This signal is divided down to 4.0210 MHz by a 10:1 divider and applied to the (A33) Digit Shift module.

3-23. The 10 Hz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "d" Gate. With a 30 Hz command present, a 33 MHz signal is passed through the "d" Gate and applied to the (A33) Digit Shift module, where it is divided down to 3.3 MHz by a 10:1 divider. The (A15) "D" Gate supplies a 33 MHz signal to the (A33) Digit Shift module where it is combined in an additive mixer with the 4.0210 MHz output of the (A34) Digit Shift module. The resulting 37.0210 MHz signal is then combined in a second additive mixer with the 3.3 MHz signal derived from the (A15) "d" Gate, thus yielding a 40.3210 MHz signal. This signal is divided down to 4.03210 MHz by a 10:1 divider and applied to the (A32) Digit Shift module.

3-24. The 100 Hz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "e" Gate. With a 400 Hz command present, a 34 MHz signal is passed through the "e" Gate and applied to the (A32) Digit Shift module, where it is divided down to 3.4 MHz by a 10:1 divider. The (A15) "E" Gate supplies a 33 MHz signal to the (A32) Digit Shift module where it is combined in an additive mixer with the 4.03210 MHz output of the (A33) Digit Shift module. The resulting 37.03210 MHz signal is then combined in a second additive mixer with the 3.4 MHz signal derived from the (A15) "e" Gate, thus yielding a 40.43210 MHz signal. This signal is divided down to 4.043210 MHz by a 10:1 divider and applied to the (A30) Digit Shift Mixer No. 1 module.

3-25. The 1 kHz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "f" Gate. With a 5 kHz command present, a 35 MHz signal is passed by the "f" Gate, divided down to 3.5 MHz by the (A31) 10:1 Divider No. 1 module, and applied to the (A28) Digit Shift Mixer No. 2 module. The (A15) "F" Gate supplies a 33 MHz signal to the (A30) Digit Shift Mixer No. 1 module where it is combined in an additive mixer with the 4.043210 MHz output of the (A32) Digit Shift module. The resulting 37.043210 MHz signal is applied to the (A28) Digit Shift Mixer No. 2 module and combined in an additive mixer with the 3.5 MHz signal derived from the (A15) "f" Gate. The resulting 40.543210 MHz signal is applied to the (A29) 10:1 Divider No. 2 module where it is divided down to 4.0543210 MHz and applied to the (A26) Digit Shift Mixer No. 1 module.

3-26. The 10 kHz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "g" Gate. With a 60 kHz command present, a 36 MHz signal is passed by the "g" Gate, divided down to 3.6 MHz by the (A27) 10:1 Divider No. 1 module, and applied to the (A24) Digit Shift Mixer No. 2 module. The (A15) "G" Gate supplies a 33 MHz signal to the (A26) Digit Shift Mixer No. 1 module where it is combined in an additive mixer with the 4.0543210 MHz output of the (A29) 10:1 Divider No. 2 module. The resulting 37.0543210 MHz signal is applied to the (A24) Digit Shift Mixer No. 2 module and combined in an additive mixer with the 3.6 MHz signal derived from the (A15) "g" Gate. The resulting 40.6543210 MHz signal is applied to the (A25) 10:1 Divider No. 2 module where it is divided down to 4.06543210 MHz and applied to the (A17) Digit Adder Mixer No. 1 module.

3-27. The 100 kHz decade commands control selection of the Comb frequencies applied to the (A15) Gate Matrix "h" Gate. With a 700 kHz command present, a 37 MHz signal is passed by the "h" Gate, divided down to 3.7 MHz by the (A19) 10:1 Divider No. 1, and applied to the (A18) Digit Adder Mixer No. 2 module. The (A15) "H" Gate supplies a 33 MHz signal to the (A17) Digit Adder Mixer No. 1 module where it is combined in an additive mixer with the 4.06543210 MHz output of the (A25) 10:1 Divider No. 2 module. The resulting 37.06543210 MHz signal is passed through the (A21) DAM/Search Oscillator Filter module and applied to the (A18) Digit Adder Mixer No. 2 module where it is combined with the 3.7 MHz signal derived from the (A15) "h" Gate. The resulting 40.76543210 MHz signal is passed through the (A16) and (A20) Digit Adder Mixer Filter No. 2 and No. 3 modules and becomes the final Subsynthesizer output signal. This signal is then applied to the (A8) 1st Up Converter module located in the UHF Section of the synthesizer.

3-28. UHF Section (Figure 3-4)

3-29. The UHF Section consists of a drift cancelling loop which employes a 370 to 410 MHz and a 410 to 420 MHz signal in two separate paths. The 370 to 410 MHz path is selected in 10 MHz increments with the 10 MHz frequency decade. It also contains a feedback path for amplitude compensation of the preselected output. The other path of the loop consists of a 410 to 420 MHz signal which is obtained by combining a 370 to 410 MHz signal with 30 to 70 MHz, 40 to 41 MHz, and 30 to 39 MHz signals from the Input and Subsynthesizer Sections. These UHF loop signals are then combined in a subtractive mixer, thus yielding the 0 to 50 MHz preselected output frequency of the synthesizer.

NOTE!

For explanation purposes, the previously established frequency setting of 38765432.10 Hz is still in effect.

3-30. The 10 MHz decade commands determine the output frequency of the (A1) Oscillator module and the selection of the 30 to 70 MHz signal applied to the (A5) Input Mixer module. With a 30 MHz command present, the (A1) Oscillator module output frequency is 380 MHz. A 40 MHz signal is also applied to the (A5) Input Mixer module. The 380 MHz signal is first amplified with the (A3) 390 MHz 3 STG. Amplifier module and then applied to the (A5) Input Mixer module. A subtractive mixer combines the two signals of 380 and 40 MHz. The resulting 340 MHz signal is filtered and amplified with the (A6) 340 MHz Filter and (A4) 340 MHz 3 STG. Amplifier module and applied to the (A8) 1st Up Converter module. The (A8) 1st Up Converter module combines the 340 MHz signal and previously described 40.76543210 MHz signal from the Subsynthesizer in an additive mixer, which yields a 380.76543210 MHz resultant. This signal is filtered and amplified with the (A7) 380.5 MHz Filter and (A9) 380 MHz 3 STG. Amplifier module and applied to the (A12) 2nd Up Converter module.

3-31. The 1 MHz decade commands control selection of the 30 to 39 MHz Comb signals applied to the (A4A9) 30-39 MHz Gate module contained in the Subsynthesizer. With an 8 MHz command present, the (A4A9) 30-39 MHz Gate module passes a 38 MHz signal to the (A12) 2nd Up Converter module located in the UHF Section. The signal is then combined in an additive mixer with the 380.76543210 MHz signal from the (A9) 380 MHz 3 STG. Amplifier module. The resulting 418.76543210 MHz signal is then filtered and amplified with the (A13) 415 MHz Filter and (A11) 415 MHz 3 STG. Amplifier module and applied to the (A15) Output Mixer module. The (A15) Output Mixer module combines the 418.76543210 MHz signal in a subtractive mixer with a 380 MHz amplitude compensated signal derived from the (A1) Oscillator and (A2) AGC Amplifier modules. The resulting 38765432.10 Hz signal, which is the preselected synthesizer output signal, is then amplified with the (A14) Output Amplifier module to provide the 0 to 100 kHz and 50 Hz to 50 MHz outputs.

3-32. Feedback from the 50 Hz to 50 MHz output amplifier allows this output to be amplitude controlled with the Automatic Level Control (ALC) feature. When the OUTPUT control is placed to the ALC position, the feedback signal is compared in the (A10) Amplitude Control module to a reference voltage established by the LEVEL control, thus producing a closely controlled output signal level from 20 kHz to 50 MHz. Placing the OUTPUT control to the FIXED 1V RMS position disables the (A10) Amplitude Control module, and the 0 to 100 kHz and 50 Hz to 50 MHz outputs are preset to respective levels of 0.1 and 1.0 volts rms.

3-33. When the OUTPUT control is placed to the AM position, the (A10) Amplitude Control module functions as an input amplifier for signals applied to the EXTERNAL MODULATION INPUT connector. An external modulation input signal at nominally 1.0 volts rms will produce 50% modulation of both the 0 to 100 kHz and 50 Hz to 50 MHz outputs. Refer to the Section II for exact modulation values.

3-34. Fixed Outputs (See Figure 3-1)

3-35. Two fixed output signals of 5 and 10 MHz are available at individual rear panel output connectors. The 5 MHz SYNTHESIZER OUTPUT is produced from an output of the (A7) 5 MHz Filter Amplifier module and is preset to a level of 1.0 volt rms into 50 ohms. The 10 MHz SYNTHESIZER OUTPUT is produced from an output of the (A8) Spectrum Generator module and is also preset at a level of 1.0 volt rms into 50 ohms.

3-36. Search Digit Interpolator Functions (Figure 3-5)

3-37. A capability of continuously varying the 0.01 Hz through 100 kHz frequency decades above or below their

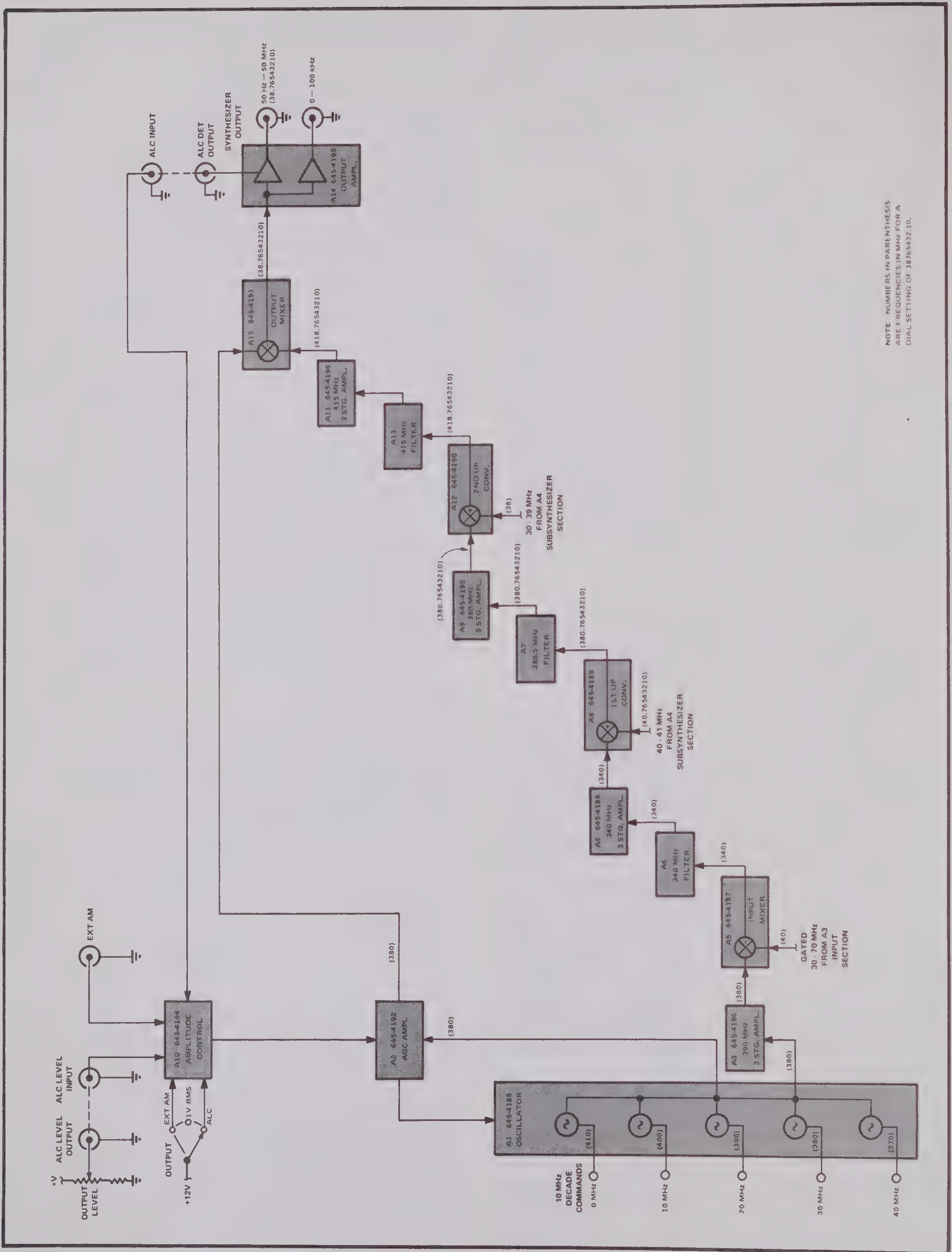

OUTPUT LEVEL
+V
ALC LEVEL OUTPUT
ALC LEVEL INPUT
EXT AM
+12V
OUTPUT
EXT AM
1V RMS
ALC
A10 645-4194 AMPLITUDE CONTROL
A2 645-4192 AGC AMPL
(380)
(380)
A1 645-4185 OSCILLATOR
(410)
(400)
(390)
(380)
(370)
10 MHz DECADE COMMANDS
0 MHz
10 MHz
20 MHz
30 MHz
40 MHz
A3 645-4186 390 MHz 3 STG. AMPL.
(380)
(380)
A5 645-4187 INPUT MIXER
(40)
GATED 30 - 70 MHz FROM A3 INPUT SECTION
(340)
A6 340 MHz FILTER
(340)
A4 645-4188 340 MHz 3 STG. AMPL.
(340)
A8 645-4189 1ST UP CONV.
(40.76543210)
40 - 41 MHz FROM A4 SUBSYNTHESIZER SECTION
(380.76543210)
A7 380.5 MHz FILTER
(380.76543210)
A9 645-4195 380 MHz 3 STG. AMPL.
(380.76543210)
A12 645-4190 2ND UP CONV.
(38)
30 - 39 MHz FROM A4 SUBSYNTHESIZER SECTION
(418.76543210)
A13 415 MHz FILTER
(418.76543210)
A11 645-4196 415 MHz 3 STG. AMPL.
(418.76543210)
A15 645-4191 OUTPUT MIXER
(38.76543210)
A14 645-4193 OUTPUT AMPL.
ALC INPUT
ALC DET OUTPUT
SYNTHESIZER OUTPUT
50 Hz — 50 MHz (38.76543210)
0 — 100 kHz
NOTE NUMBERS IN PARENTHESIS ARE FREQUENCIES IN MHz FOR A DIAL SETTING OF 38765432.10.

Figure 3-4. UHF SECTION BLOCK DIAGRAM

specific digit value is provided by the Search Digit Interpolator feature. The amount of frequency deviation is adjustable, or can be swept at a predetermined interval, thus providing a conventional search or swept frequency operation.

3-38. The (A23) Search Oscillator module receives a dc control voltage from the (A2) Front Panel assembly. This dc control voltage is derived from either the DIGIT INTERPOLATOR Dial, the Sweep Generator (IC1-IC3) or the rear panel REMOTE SEARCH connector. Selection of these dc control voltages is determined by the position of the SEARCH DIGIT INTERPOLATOR MODE switch. A 2.9 to 3.1 MHz signal is developed by the (A23) Search Oscillator module, which is proportional to a –10 to +10 volt dc control voltage. If the front panel DIGIT INTERPOLATOR Dial dc control is selected, the 2.9 to 3.1 MHz signal is proportional to the –1.0 to +1.0 settings of this control. A selected remote dc control voltage will provide the same results. If the Front Panel Sweep Generator output is selected, a dc control voltage of –10 to +10, –5 to +5, or –2 to +2 volts dc, which corresponds to the x1, x5, and x.2 settings of the SWEEP WIDTH control, is provided. The half-cycle sweep time of this sweep voltage is determined by the position of the SWEEP TIME-SEC control.

3-39. The resulting 2.9 to 3.1 MHz output of the (A23) Search Oscillator module is applied to the (A22) Search Oscillator Mixer module. An additive mixer contained in the module combines this signal with a 30 MHz signal to produce a 33 + ΔS MHz signal. The resulting signal is

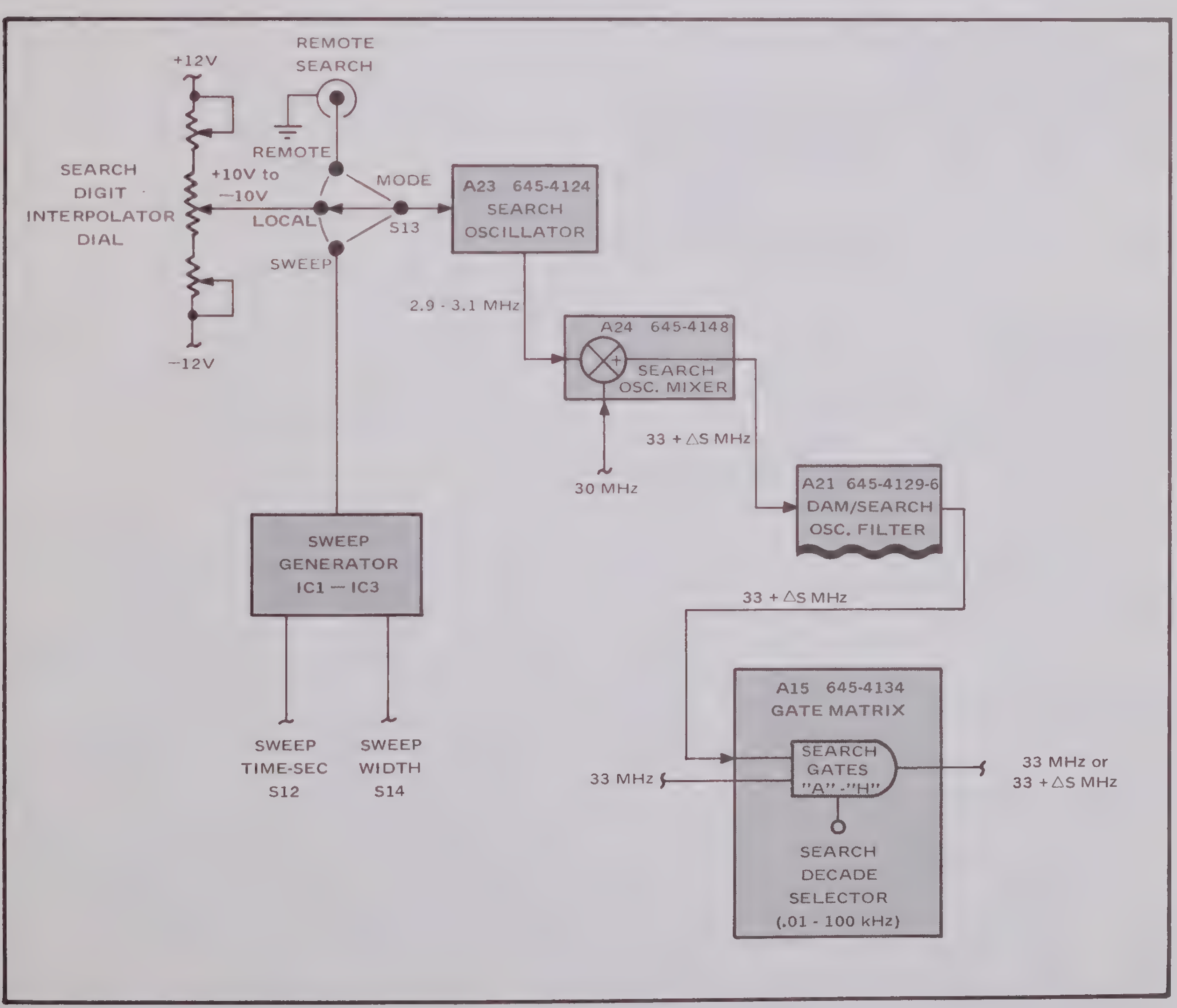

REMOTE SEARCH
+12V
SEARCH DIGIT INTERPOLATOR DIAL
REMOTE
+10V to –10V
MODE
LOCAL
S13
SWEEP
–12V
A23 645-4124 SEARCH OSCILLATOR
2.9 - 3.1 MHz
A24 645-4148 SEARCH OSC. MIXER
33 + ΔS MHz
30 MHz
A21 645-4129-6 DAM/SEARCH OSC. FILTER
SWEEP GENERATOR IC1 — IC3
33 + ΔS MHz
A15 645-4134 GATE MATRIX
SEARCH GATES "A" - "H"
33 MHz
33 MHz or 33 + ΔS MHz
SEARCH DECADE SELECTOR (.01 - 100 kHz)
SWEEP TIME-SEC S12
SWEEP WIDTH S14

Figure 3-5. SEARCH DIGIT INTERPOLATOR BLOCK DIAGRAM

filtered by the (A21) DAM/Search Oscillator Filter module and applied to the (A15) Gate Matrix "A" through "H" Gates described in the preceding Third Order Synthesis paragraphs.

3-40. When the front panel DECADE SELECTOR control is placed to a .01 through 100k position, the corresponding (A15) Gate Matrix "A" through "H" Gate is activated, which blocks the 33 MHz signal normally applied to the associated Digit Shift or Digit Adder Mixer module. A 33 + ΔS MHz search signal is then applied to the associated module and causes that particular frequency decade to be offset by the amount of the Search Digit Interpolator deviation. An example of this deviation with a Frequency Dial setting of 38765432.10 and a DECADE SELECTOR setting of 100k is shown in Table 3-1.

Table 3-1. SEARCH DIGIT INTERPOLATOR

DIGIT INTERPOLATOR DIAL SETTING	(A15) "H" GATE OUTPUT	SYNTHESIZER OUTPUT FREQ.
0	33.0 MHz	38765432.10 Hz
+1.0	33.1 MHz	38865432.10 Hz
−1.0	32.9 MHz	38665432.10 Hz

3-41. Options

3-42. 1 TO 5 MHz MULTIPLIER. When the -06 1 to 5 MHz Multiplier Option is installed in the synthesizer, a 1 MHz reference frequency can be used to drive the synthesizer; however, the noise specifications of the synthesizer will be degraded slightly by the multiplication factor of this option. A block diagram of the 1 to 5 MHz Multiplier module is shown in Figure 3-6.

3-43. The 1 MHz reference drive signal is applied to the (A3A12) 1 to 5 MHz Multiplier module where it is multiplied to 5 MHz by a x5 multiplier. The resulting signal is then amplified to provide a 1.0 volt rms 5 MHz reference drive signal for the synthesizer.

3-44. BASIC CIRCUITS

3-45. The circuitry contained in the synthesizer is completely solid-state and composed of both transistors and integrated circuits. Special types of circuits are discussed in the following paragraphs.

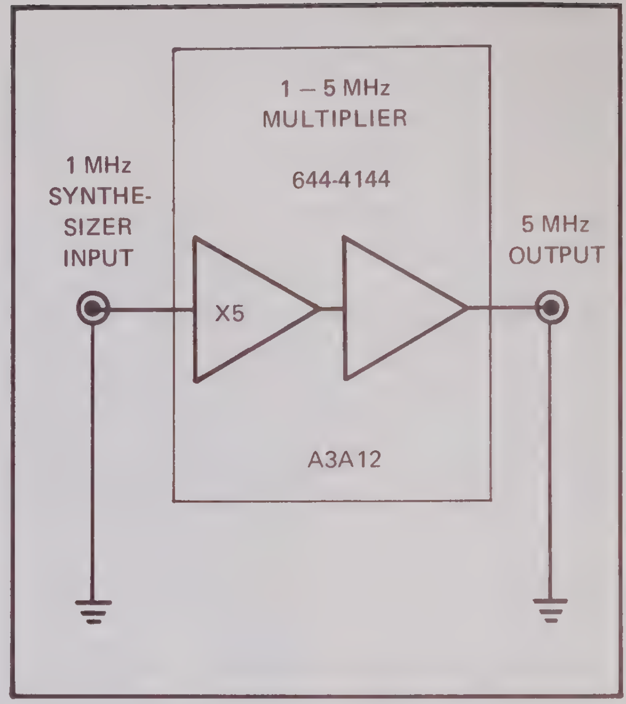


Figure 3-6. 1 – 5 MHz MULTIPLIER BLOCK DIAGRAM

3-46. Transistor Circuits

3-47. Most of the transistor circuitry in the synthesizer is connected to operate in a conventional common-base, common-emitter, or common-collector manner. However, certain special circuits have been employed to achieve limiting and mixing processes. These special circuits are described in the following paragraphs.

3-48. VOLTAGE LIMITER. The voltage limiter shown in Figure 3-7 is used to maintain a constant amplitude output signal over a wide range of input signal amplitude variations. Whenever the input signal at Q1 goes positive, Q1 conducts to the maximum available current supplied through R3. Transistor Q2 is cut-off during this interval and no output signal is developed across R_L. When the input signal to Q1 goes negative, Q1 is cut-off and Q2 conducts to the maximum available current supplied through R3. Because the maximum amount of current through R_L is proportional to the current from R3, the output signal developed across R_L is a symmetrical squarewave that is independent of any input signal level variations. If R_L is replaced with a tuned circuit, the output signal will approach that of a sinewave.

3-49. BALANCED FET MIXER. The balanced FET mixer shown in Figure 3-8 combines the two input signals

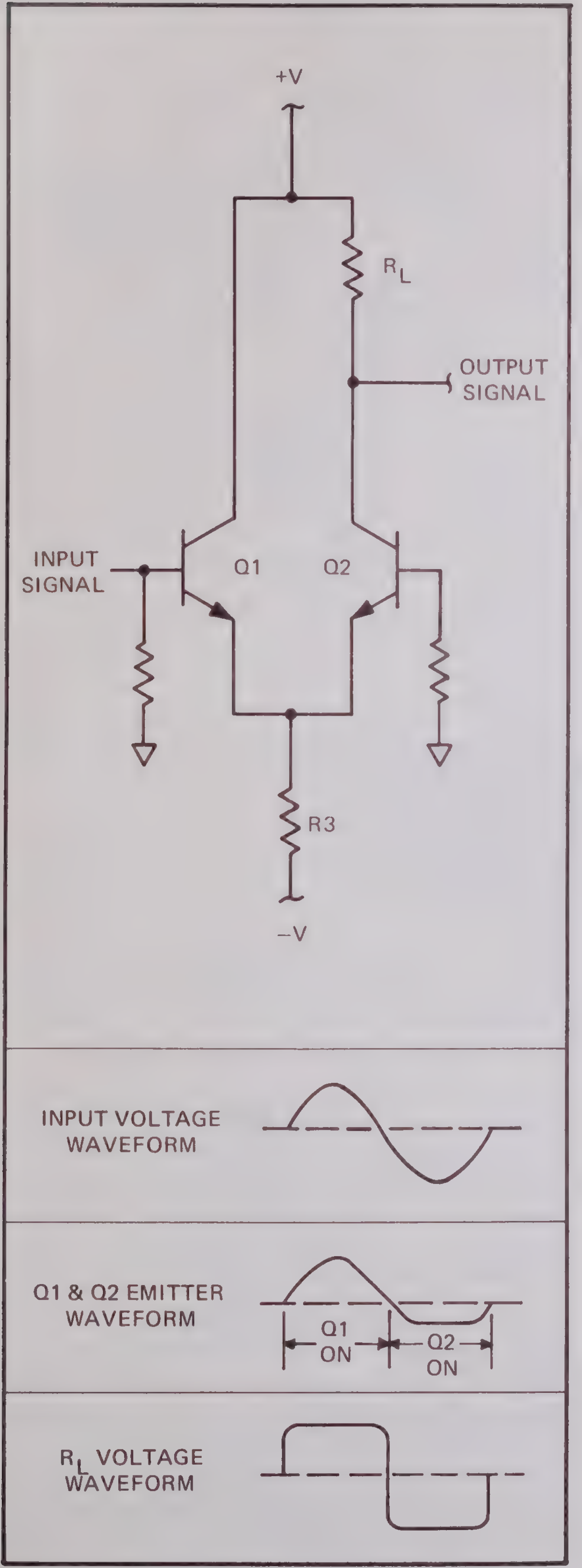


Figure 3-7. VOLTAGE LIMITER – TRANSISTOR

in such a manner as to produce a double side band, suppressed high frequency carrier output. The dual gate MOS FET transistors, Q1 and Q2, are source current/gate voltage (gm) amplifiers. The gate number 1 to drain forward transconductance in a function of gate number 2 to source voltage. Gate number 2 to drain transconductance is a function of gate number 1 to source voltage. This interdependance results in high level mixing characteristics with low level spurious outputs.

3-50. The low frequency input is differentially applied by T1 to gate number 2 of Q1 and Q2. Resistors R1 and R2 provide proper bias for low spurious frequency generation. The high frequency input is also differentially applied by L1 to gate number 1 of Q1 and Q2. Conduction of Q1 and Q2 then combines the input signals and produces the sum, difference, and low frequency carrier at the load. The high frequency carrier is suppressed by the differential input to Q1 and Q2. The degree of high frequency carrier suppression depends on the differential transconductance between Q1 and Q2, which is adjustable with R3. The resonant circuit consisting of L2 selects the desired sum or difference frequency output. The low frequency carrier is suppressed by the Q of the resonant output circuit.

3-51. Integrated Circuits

3-52. A large amount of the circuitry contained in the synthesizer consists of integrated circuits. These integrated circuits are used to perform the mixing, amplification, division, and limiting functions required in the synthesizing process. A description of each integrated circuit function is given in the following paragraphs.

3-53. BALANCED MIXER. The integrated circuit shown in Figure 3-9 is a balanced differential/cascode amplifier connected to function as a balanced mixer. High frequency input signals are applied to the current source transistor Q3 and switch the current source on and off. The high frequency switched current from Q3 is equally divided between Q1 and Q2 and then summed in the center tapped primary of T2. Since these currents are in-phase, the high frequency carrier is suppressed at the output, which greatly reduces filtering requirements for this high frequency component. The low frequency input is transformer coupled by T1 to the bases of Q1 and Q2. The phase difference between the base signals is 180°. Transistors Q1 and Q2 conduction varies alternately in a linear push-pull fashion at the low frequency rate, which modulates the high frequency switching signal and produces a double side band, suppressed high frequency carrier output. The degree of high

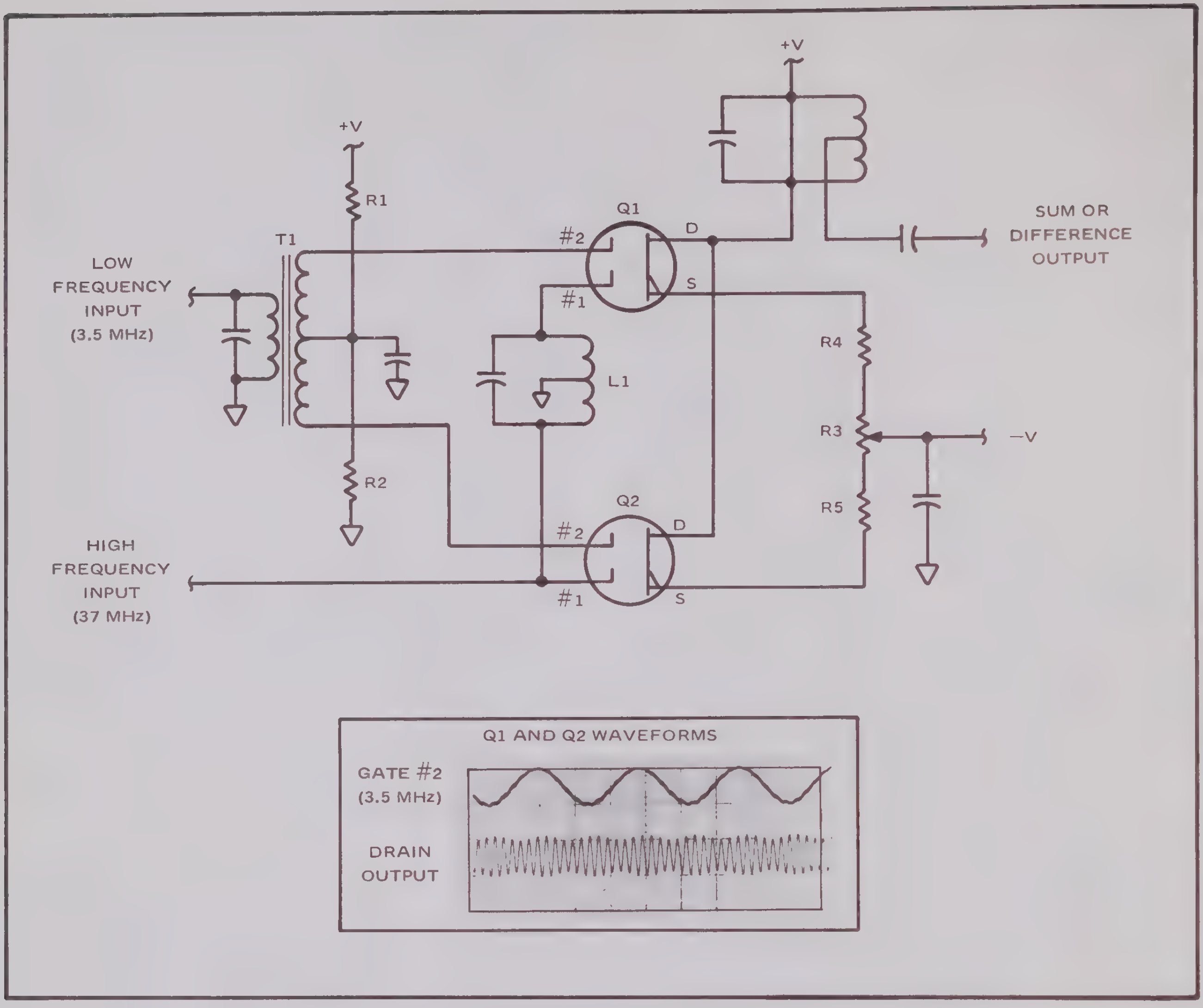


Figure 3-8. BALANCED FET MIXER

frequency carrier suppression depends on the balance between Q1 and Q2 and the placement of the center-tap in the primary of T2. Selection of the sum or difference side band is accomplished by tuning the secondary of T2 to the desired frequency. Low frequency carrier rejection is provided by the Q of the resonant output circuit.

3-54. LIMITER AMPLIFIER. The integrated circuit balanced differential/cascode amplifier can also be connected to function as a limiter amplifier. Circuit connections are shown in Figure 3-10. Whenever the high level input signal at Q1 goes positive, Q1 conducts to the maximum available current supplied by the current source, Q3. Transistor Q2 is cut off during this interval and no output signal is developed across R_L. When the input signal to Q1 goes negative, Q1 is cut-off and Q2 conducts to the maximum available current supplied by Q3. Because the maximum current through R_L is proportional to the current from Q3, the output signal developed across R_L is a symmetrical square wave that is independant of input signal level variations. If R_L is replaced with a tuned circuit, the output signal will approach that of a sinewave.

3-55. DIGITAL DIVIDERS. The integrated circuits shown in Figure- 3-11 are dual J-K Flip-Flops connected to operate on a divide by 2/divide by 5 mode, thus providing an overall division of 10:1. A 2:1 divider is formed using a single J-K Flip-Flop with the J and K input left high. The 5:1 divider is formed by interconnecting three J-K Flip-Flops as a circulating counter. Exact logic conditions for the 5:1 divider are given in the truth table located in Figure 3-11. Resistors R1 through R3 reduce the second and third harmonics present at the divider output.

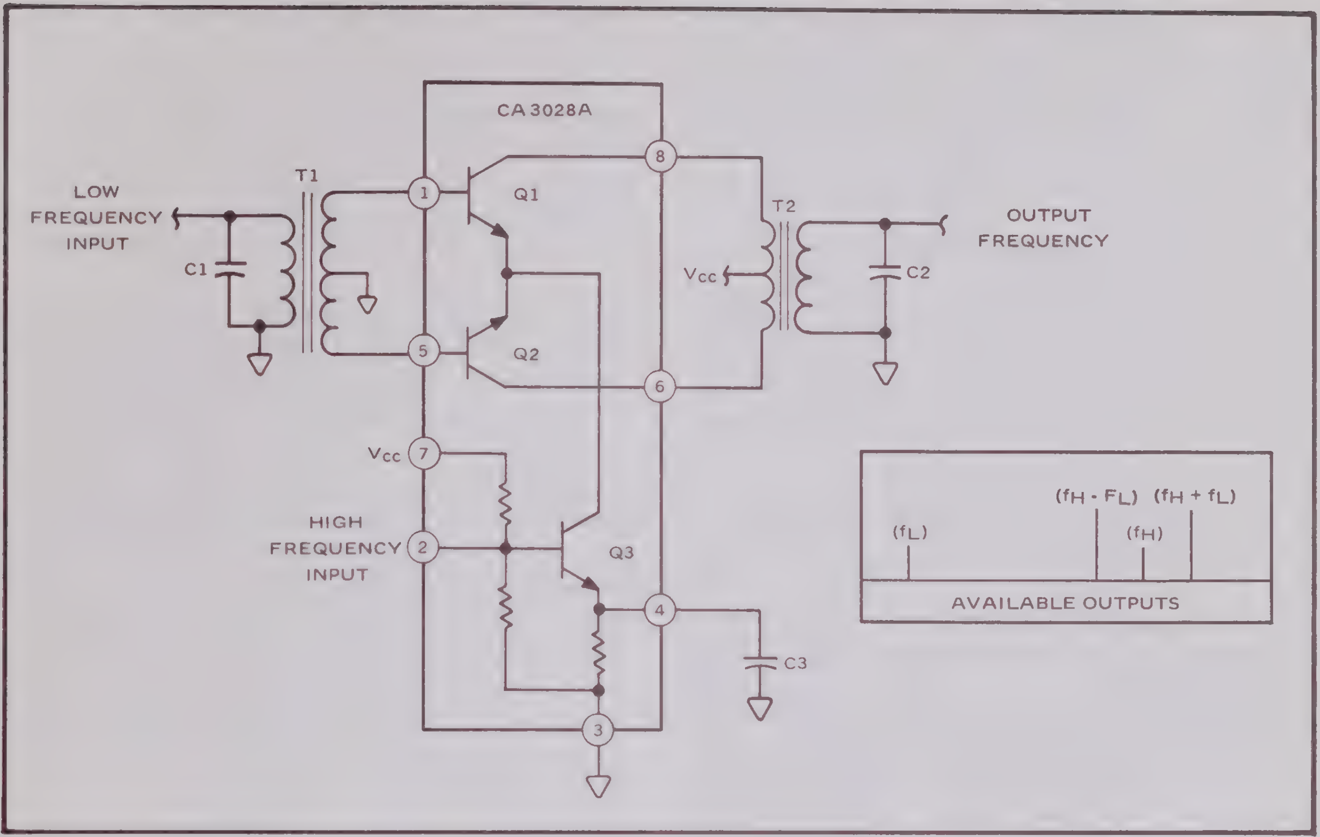

CA 3028A
LOW
FREQUENCY
INPUT
T1
C1
1
5
Q1
Q2
8
6
T2
Vcc
C2
OUTPUT
FREQUENCY
Vcc
7
HIGH
FREQUENCY
INPUT
2
Q3
4
C3
3
(fH - FL)
(fH + fL)
(fL)
(fH)
AVAILABLE OUTPUTS

Figure 3-9. INTEGRATED CIRCUIT BALANCED MIXER

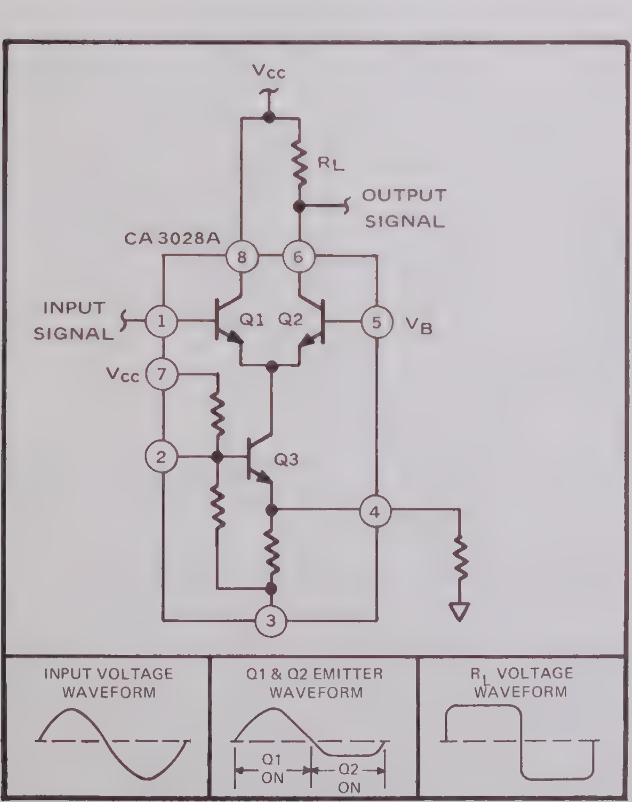
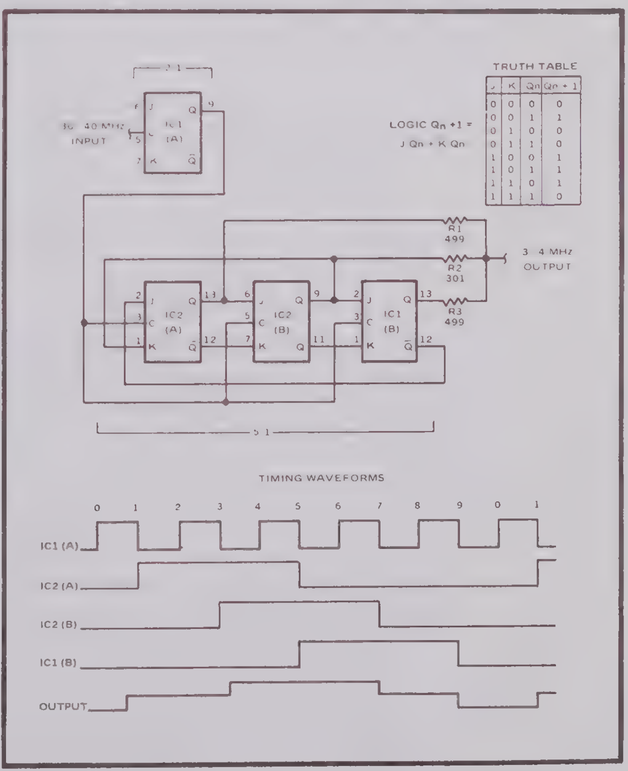

Vcc
RL
OUTPUT
SIGNAL
CA 3028A
8
6
INPUT
SIGNAL
1
Q1
Q2
5
VB
Vcc
7
2
Q3
4
3
INPUT VOLTAGE
WAVEFORM
Q1 & Q2 EMITTER
WAVEFORM
Q1
ON
Q2
ON
RL VOLTAGE
WAVEFORM

Figure 3-10. INTEGRATED CIRCUIT LIMITER AMPLIFIER


2:1
30 40 MHz
INPUT
IC1
(A)
J
C
K
Q
Q̄
6
5
7
9
LOGIC Qn +1 =
J Qn + K Qn
R1
499
R2
301
R3
499
3 4 MHz
OUTPUT
IC2
(A)
IC2
(B)
IC1
(B)
2
3
1
13
12
6
5
7
9
11
2
3
1
13
12
5:1
TIMING WAVEFORMS
0
1
2
3
4
5
6
7
8
9
0
1
IC1 (A)
IC2 (A)
IC2 (B)
IC1 (B)
OUTPUT

TRUTH TABLE

J	K	Qn	Qn + 1
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Figure 3-11. 10:1 DIGITAL DIVIDER (DIVIDE BY 2/DIVIDE BY 5 MODE)

3-56. A 10:1 digital divider connected to operate on a divide by 5/divide by 2 mode is shown in Figure 3-12. The divide by 5 and divide by 2 circuits operate in the same manner as described in paragraph 3-54. However, since the output is a symmetrical waveform, it contains only odd harmonics and resistive filtering is not required.

3-57. CIRCUIT DESCRIPTIONS

3-58. The following paragraphs describe in detail the circuitry contained in the synthesizer. Schematic diagrams of each module are located at the rear of this manual. Refer to paragraph 3-10 for schematic diagram numbering information.

3-59. 5 MHz Filter Amplifier Module (645-4101)

3-60. The 5 MHz Filter Amplifier Module receives the 5 MHz synthesizer drive signal and produces a 5 and 10 MHz output signal. The 5 MHz input at J1 is applied to the tuned-limiter amplifier consisting of Q1, Q2 and L2. This circuit functions as a limiter for high level inputs. Variable resistor R8 provides adjustment of the output signal level. The resulting constant amplitude output of Q2 is then processed by two crystal filters Y1 and Y2 to remove close in noise. The tuned driver Q3 provides sufficient gain of the filtered signal. The tuned driver Q4 amplifies the filtered 5 MHz signal and produces a 1.0 volt rms into 50 ohm output level at J2. Variable resistor R17 allows adjustment of the signal level at J2. The 5 MHz filtered output is also coupled by T3 to a push-pull frequency doubler composed of Q5 and Q6. The resonant circuit of L4, C23, and C24 select the 10 MHz output signal from the Q5 and Q6 and applied the signal to the output connector J3. Variable resistor R25 is adjusted to suppress the 5 MHz output from the frequency doubler.

3-61. Spectrum Generator Module (645-4102)

3-62. The Spectrum Generator Module receives a 10 MHz input signal and produces six separate output signals of 10 and 30 through 70 MHz, in 10 MHz increments. The 10 MHz input at J1 is applied to the two tuned driver amplifiers, Q1 and Q2. Transistor Q1 amplifies the signal and provides a 1.0 volt rms into 50 ohm output at J2. Variable resistor R2 allows adjustment of the signal level at J2. Transistor Q2 amplifies the 10 MHz input sufficiently to drive the harmonic generator consisting of step diode CR1. The resulting rich in harmonic output of CR1 is then passed through a low-pass filter consisting of C14 through C16, L5, L6, and R13 through R15. The resonant harmonic selectors of T3 through T7 select the corresponding 30 through 70 MHz signal components and apply the signals to the associated output connectors.

3-63. Harmonic Selector Modules (645-4103 thru -4107

3-64. The Harmonic Selector Modules receive input signals of 30 to 70 MHz and produce constant amplitude

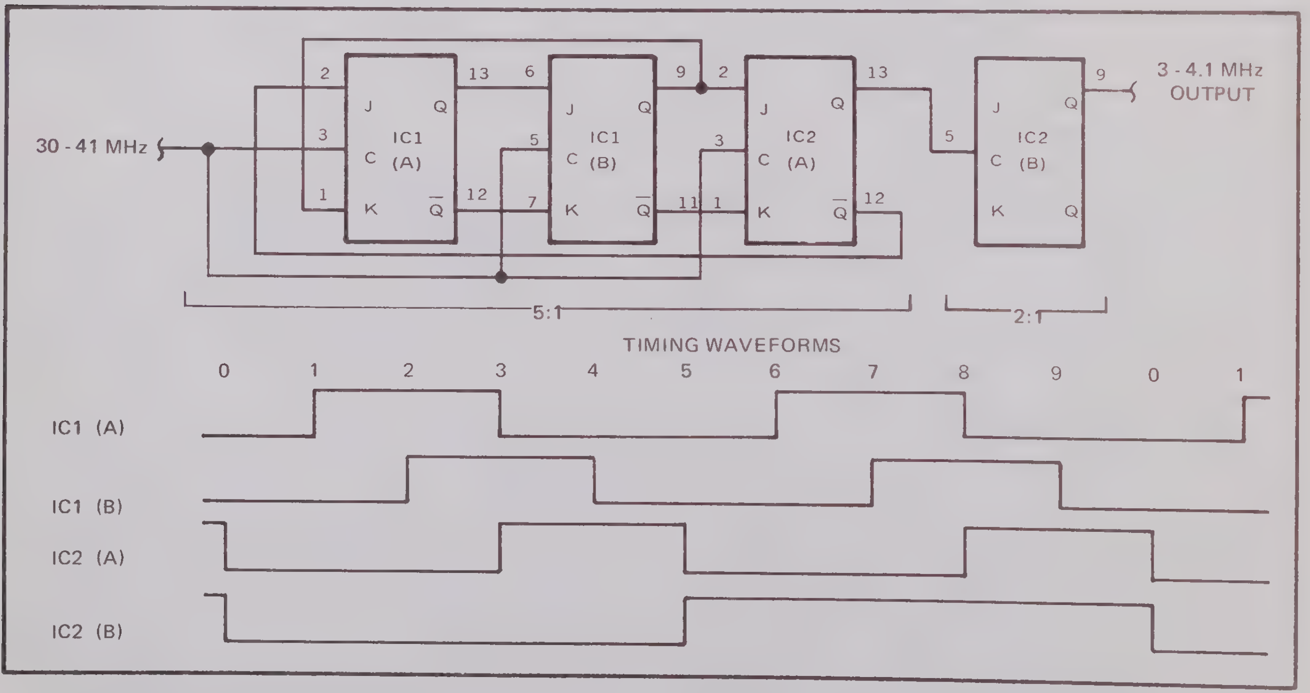


Figure 3-12. 10:1 DIGITAL DIVIDER (DIVIDE BY 5/DIVIDE BY 2 MODE)

gated outputs under the control of the 10 MHz frequency decade. Separate buffered outputs at 30 and 40 MHz are also provided, as well as a 35 MHz output derived from the 70 MHz signal. Since the operation of each Harmonic Selector Module is essentially the same, only the 30 MHz Harmonic Selector Module is described. The 2:1 divider contained in the 70 MHz Harmonic Selector Module is described in paragraph 3-66.

3-65. The 30 MHz input at J1 is amplified by the low-noise FET amplifier, Q1. Inductors L3 and L8 provide the necessary impedance matching and signal filtering for this stage. The amplified and filtered output of Q1 is then applied to the integrated circuit limiter, IC1. Inductor L9 selects the resulting constant amplitude output of IC1 and rejects the unwanted side bands. Capacitor C15 couples the signal to the driver Q3, which produces a buffered 30 MHz output at J2. The common-base amplifier Q2 and diodes CR1 through CR3 form an rf gate which passes or blocks the signal to J3. This rf gate is switched on only when a 40 MHz decade command exists and is off during all other commands. The presence of the +12 volt 40 MHz CONTROL input switches Q2, CR1, and CR2 into conduction and turns CR3 off. With the rf gate on, the 30 MHz signal is amplified by Q2, filtered by L11 and applied to the output connector, J3. (The voltage developed across CR3 and R24 whenever the rf gate is on also turns on an rf gate located in the Buss Block connected to J3.) When the rf gate is turned off, the diode CR3 conducts through R25 and provides an rf shunt at their junction. This action also develops a voltage which turns off the rf gate located in the associated Buss Block.

3-66. The 2:1 divider contained in the 70 MHz Harmonic Selector Module consists of an integrated circuit divide-by-two flip-flop. Input signals to IC2 are divided down to 35 MHz and then passed through a bandpass filter composed of L10 and C21 through C24 to reduce harmonic and spurious products. The resulting filtering signal is then coupled by C25 to the output connector, J2.

3-67. 30 and 40 MHz 10:1 Divider Modules (645-4108 and -4109)

3-68. The 10:1 Divider Modules receive input signals of 30 or 40 MHz and produce respective buffered outputs, in addition to 3 or 4 MHz output signals. Since the operation of both modules is essentially the same, only the 30 MHz 10:1 Divider Module is described.

3-69. The 30 MHz input at J3 is amplified by the tuned amplifier Q1 and the resulting signal applied to two separate stages, Q2 and IC1. Transistor Q2 is a tuned amplifier and produces a buffered 30 MHz output at J2. Variable resistor R8 allows adjustment of the signal level at J2. Integrated circuit IC1 functions as a limiter and produces a constant level signal which is selected by L6. Capacitor C15 couples the signal to the 10:1 divider composed of IC2 and IC3. Integrated circuits IC2 and IC3 are JK flip-flops which are interconnected in a divide by 5/divide by 2 mode. The resulting 3 MHz output is processed by the low pass filter composed of R18, R19, and C20 and the bandpass filter T1 and C22 to reduce harmonic and spurious products. Transformer T1 also couples the filtered 3 MHz signal to the output connector, J1. Variable resistor R19 allows adjust–ment of the signal level at J1.

3-70. Mixer Modules (645-4121 thru -4128)

3-71. The Mixer Modules combine two input signals in a mixer which yields the sum or difference frequency of 31 through 34 and 36 through 39 MHz. Low frequency input signals are either 3 or 4 MHz and high frequency inputs are 30, 35, or 40 MHz. Table 3-2 lists the input and output frequencies of each module. Since the operation of each module is essentially the same, only the 31 MHz Mixer Module is described.

Table 3-2. MIXER MODULE INPUT AND OUTPUT FREQUENCIES

MODULE	INPUT FREQUENCIES		OUTPUT FREQUENCY
645-4121	4	35	31
645-4122	3	35	32
645-4123	3	30	33
645-4124	4	30	34
645-4125	4	40	36
645-4126	3	40	37
645-4127	3	35	38
645-4128	4	35	39

3-72. The 4 MHz input at J3 is transformer coupled by T1 to one input gate of the dual gate MOS FET mixer, Q2 and Q3. A 35 MHz input at J1 is amplified by the tuned driver Q1 and applied to the other gates of Q2 and Q3 by the resonant circuit consisting of L3 and L4. The balanced MOS FET mixer provides high level mixing with low level spurious responses. The resonant circuit composed of L6 and C14 selects the desired 31 MHz difference frequency and C16 couples the signal to the output connector J3. Variable resistor R14 is adjusted to suppress any 35 MHz carrier output from the balanced mixer.

3-73. 30 - 39 MHz Filter Modules (645-4129-1 thru -5)

3-74. The 30 - 39 MHz Filter Modules process the output signals from the Mixer Modules and provide a separate buffered and gated output for each signal. The gated outputs are controlled by the 1 MHz frequency decade commands. Each module consists of two separate assemblies which process pairs of frequencies from 30/35 to 34/39 MHz. Since the operation of each module assembly is essentially the same, only the 30 MHz portion of the 30/35 MHz Filter Module is described.

3-75. The 30 MHz input at J3 is processed by a four pole filter composed of L1 through L4 and C1 through C9 to remove harmonic and spurious products. The driver Q1 amplifies the filtered signal, which is then amplitude limited by Q2 and Q3. Capacitor C14 couples the constant amplitude signal to the output driver Q4, which produces a buffered 30 MHz output at J2. The three pole filter composed of L5 through L7 and C17 through C22 also process the constant amplitude output of Q2 and Q3 and applies the signal to the driver amplifier, Q5. When a zero, 1 MHz frequency decade command exists, a +12 volt dc CONTROL input switches Q5 and Q6 into conduction and results in the presence of a gated 30 MHz output at J1. The dc bias developed across R17 and R23 also turns on the associated amplifier stage in the 30 - 39 MHz Gate Module.

3-76. 30 - 39 MHz Gate Module (645-4133)

3-77. The 30 - 39 MHz Gate Module receives the gated output from the associated Filter Module and produces a constant amplitude, filtered output signal. The gated input at J1 through J9 is amplified by the associated two-stage amplifier consisting of Q1/Q2 through Q20/Q19. The first stage of each amplifier group is switched into conduction by the gated bias voltage developed in the associated Filter Module. Integrated circuit limiter IC1 receives the output of the two-stage amplifier and produces a constant amplitude signal at its terminal 8. The double-tuned circuit composed of L13 and T1 filters the constant amplitude signal to remove harmonic products and applies the signal to the output connector, J6.

3-78. Gate Matrix Module (645-4134)

3-79. The Gate Matrix Module contains 12 separate gate assemblies. Each gate assembly receives a single input frequency and provides eight separate outputs. Selection of the output signals is controlled by gating commands from the .01 through 100 kHz frequency decades and the SEARCH DECADE SELECTOR. Ten of the gates are associated with the frequency decades and receive input signals from 30 to 39 MHz, in 1 MHz steps. The remaining gates are associated with the search decade and receive input signals of 33 and 32.9 to 33.1 MHz.

3-80. Each gate assembly contains eight diode gates and a two stage amplifier. Two of the diode gates contain four diodes and the remaining six have three diodes. The only difference in operation between the two types of diode gates is that signal input diodes (CR2 and CR5) are used on the four-diode gate. For this reason only the operation of the four-diode gate is described. The two stage amplifier consists of a conventional driver amplifier and an emitter-follower.

3-81. The four-diode gate consists chiefly of four diodes whose conduction is controlled by a −12 volt source and a +12 volt gated input. Absence of the +12 volt gate at L5 causes CR2, CR3 and CR19 to be cut-off by the −12 volt source constantly applied to R1. Diode CR1 is turned on at this time and shunts any signal appearing at its cathode to ground. Application of a +12 volt gate input at L5 turns on CR2, CR3, and CR19 and cuts-off CR1. A low impedance path is then available between the diode gate input at C2 and the output at CR19. Typical insertion-loss of a diode gate is −13 db and the on-to-off isloation ratio is typically 112 db.

3-82. Search VCO Module (644-4124)

3-83. The Search VCO Module produces an output frequency signal of 3 MHz which can be deviated ±100 kHz by a ±10 volt dc control voltage. The frequency deviation sensitivity is proportional to 10 kHz per volt of the applied dc control voltage. This dc control voltage can also be varied sinusoidally at a rate of up to 2 kHz.

3-84. The heart of the Search VCO Module is the oscillator circuit comprised of differentially connected transistors Q7 and Q8. The oscillator is a modified Hartley with a temperature compensated varactor diode CR9 connected in the resonate circuit of the oscillator. This varactor diode changes the frequency of the oscillator as the input control voltage across it is varied. The input voltage to the Search VCO Module may be varied from 0 to +10 volts or from 0 to −10 volts at up to a 2 kHz sinusoidal rate. Due to nonlinearity of the varactor, voltage shaping networks are used at the input to the varactor-oscillator circuit. There are five such networks constructed around variable resistors R1 through R10. Diode pairs, CR1 through CR8, are used in each network to temperature compensate the break-point voltages of each network. Oscillator frequency drift caused by temperature and power supply variations is reduced by the use of a temperature compensated current and voltage regulator. The regulator consists of a temperature compensated reference diode CR12 driven by a constant current source produced by Q3 and Q4. Diodes CR10 and CR11 provide initial starting current for the regulator when power is initially applied to the module. The regulator provides a constant current to the differential oscillator pair by means of Q1, Q2, Q5, Q6, and a constant voltage to the linearizing network from CR12.

3-85. The oscillator signal at the collector of transistor Q8 drives limiting-amplifier Q9 and Q10. This limiting-amplifier stabilizes the output voltage level. The output of the limiting-amplifier drives a three stage low-pass filter composed of L5 through L7 and C19 through C22. This filter suppresses harmonic of the output signal.

3-86. Search Mixer Module (645-4146)

3-87. The Search Mixer Module combines two input signals of 3 ±0.1 MHz and 30 MHz in an additive mixer and produces a 33 ±0.1 MHz output signal. The nominal 3 MHz input at J3 is amplified by the common-base tuned amplifier Q1 and coupled by T1 to one input gate of the dual gate MOS FET mixer, Q4 and Q5. A 30 MHz input at J1 is amplified by the tuned driver amplifiers Q1 and Q2 and applied to the other gates of Q4 and Q5 by the resonant circuit consisting of L2 and C7. The balanced MOS FET mixer provides high level mixing with low level spurious responses. The resonant circuit of L3 and C17 selects the desired sum frequency of 33 ±0.1 MHz and applies the signal to the output connector J2. Variable resistor R20 is adjusted to suppress any 30 MHz carrier output from the mixer.

3-88. Digit Adder Filter/Search Oscillator Filter Module (645-4129-6)

3-89. This module contains two separate assemblies which process the 33 ±0.1 MHz search signal and the 37 MHz output of the Digit Adder Mixer No. 1 Module. The 33 ±0.1 MHz search input at J4 is processed by the four pole filter consisting of L1 through L4 and C1 through C9. Driver Q1 amplifies the filtered signal, which is then amplitude limited by Q2 and Q3. The three pole filter consisting of L5 through L7 and C14 through C19 processes the constant amplitude limiter output and applies the signal to the output connector J3. The 37 MHz input at J2 is processed by a four pole filter and applied to the output connector, J1.

3-90. Digit Shift Mixer Module (645-4135)

3-91. The Digit Shift Mixer Module receives three separate nominal input signals of 4, 33, and 30 - 39 MHz. These signals are then combined in additive mixers and the resultant divided by ten to produce an output frequency of 3.99 to 4.11 MHz. The 4 MHz input at J2 is processed by the bandpass filter composed of L1 and L2 to remove harmonic and spurious products and the filtered output applied to the mixer, IC1. The 33 MHz input at J1 is also processed by the bandpass filter L3 and then applied to the other input of the mixer, IC1. Integrated circuit IC1 is a balanced differential amplifier configured as a mixer. The double-tuned resonant circuit consisting of L4 and L6 selects the 36.9 to 37.1 MHz sum frequency output from IC1 and C24 couples the signal to a second mixer, IC5. A 30 to 39 MHz input at J3 is amplified by the driver Q1 and amplitude limited by the integrated circuit limiter, IC2. The resulting constant amplitude signal is transformer coupled by T1 to the complementary push-pull amplifier Q2 and Q3. The emitter output of these amplifiers is then applied to the 10:1 digital divider composed of IC3 and IC4. These integrated circuits are JK Flip-Flops connected in a divide by 5/divide by 2 mode, which produces a 3.0 to 3.9 MHz output signal at terminal 9 of IC3. The two stage filter consisting of L10 and T2 processes this signal to remove harmonic and spurious products and applies the signal to the second additive mixer, IC5. This integrated circuit functions in the same manner as IC2 and produces a sum output frequency of 39.9 to 41.1 MHz. The resonant circuit of L14 selects the desired output, which is then applied to IC6. Inductor L15 and capacitor C31 forms a two pole trap, which removes the difference frequency output of the mixer. The tuned circuit of L16 provides filtering. Integrated circuit IC6 is a tuned limiter amplifier and produces a constant amplitude signal that drives the 10:1 digital divider composed of IC7 and IC8. This divider functions in the same manner as the previously described divider composed of IC3 and IC4 and produces a 3.99 to 4.11 MHz output signal. The two stage filter consisting of L20 and L21 process the divider output to remove harmonic and spurious products and applies the signal to the output connector, J4.

3-92. 10:1 Divider No. 1 Module (645-4136)

3-93. The 10:1 Divider No. 1 Module receives an input signal of 30 to 39 MHz and produces an output signal of 3.0 to 3.9 MHz. The 30 to 39 MHz input signal at J1 is amplified by the driver Q1 and the tuned amplifier IC1. Transformer T1 selects the output of IC1 and couples the signal to the complementary push-pull amplifier of Q2 and Q3. The emitter output of this amplifier drives the following 10:1 digital divider composed of IC2 and IC3. These integrated circuits are JK Flip-Flops connected in a divide by 2/divide by 5 mode. The resulting 3.0 to 3.9 MHz output signal is processed by the two stage filter composed of L5 and L6 and applied to the output connector, J2.

3-94. 10:1 Divider No. 2 Module (645-4149)

3-95. The 10:1 Divider No. 2 Module receives an input signal of 39.9 to 41.1 MHz and produces an output signal of 3.99 to 4.11 MHz. The 39.9 to 41.1 MHz input signal at J1 is amplified by the tuned driver Q1 and limited by the integrated circuit limiter,IC1. The resulting constant amplitude output of IC1 is coupled by C15 to the following 10:1 digital divider consisting of IC2 and IC3. These integrated circuits are connected in a divide by 2/divide by 5 mode. The resulting 3.99 to 4.11 MHz output signal is processed by the two stage filter of L5 and L6 and applied to the output connector, J2.

3-96. Digit Shift Mixer No. 1 and No. 2 Modules (645-4137 and -4138)

3-97. The Digit Shift Mixer Modules combine two input signals using an additive mixer and produce an output frequency of either 36.9 to 37.2 or 39.9 to 41.1 MHz. Since the operation of either module is essentially the same, only the Digit Shift Mixer No. 1 Module is described.

3-98. The 3.99 to 4.11 MHz input at J2 is transformer coupled by T1 to one input of the dual gate MOS FET mixer, Q2 and Q3. A 32.9 to 33.1 MHz input signal at J1 is amplified by the tuned driver Q1 and applied to the other gates of Q2 and Q3 by the resonant circuit consisting of L1 and C4. The balanced MOS FET mixer provides high level mixing with low level spurious responses. The four-pole filter composed of L8 through L11 selects the 36.9 to 37.2 MHz output from the mixer, which is then applied to the output driver, Q4. The series resonant trap consisting of L11 and C22 eliminates the difference frequency output from the mixer. The collector signal of Q4 is coupled by C26 to the output connector, J3.

3-99. Digit Adder Mixer No. 1 (645-4139)

3-100. The Digit Adder Mixer No. 1 combines two input signals of 3.99 to 4.11 MHz and 32.9 to 33.1 MHz in an additive mixer and produces a 36.9 to 37.2 MHz output signal. The 3.99 to 4.11 MHz input at J3 is amplified by the common-base tuned amplifier Q3 and transformer coupled by T1 to one input of the dual gate MOS FET mixer, Q5 and Q6. A 33 MHz input at J2 is amplified by the tuned drivers Q1 and Q2 and applied to the other gates of Q5 and Q6 by the resonant circuit of L1. The balanced MOS FET mixer provides high level mixing with low level spurious responses. The resonant circuit consisting of L3 and C17 selects the desired sum frequency and C19 couples the 36.9 to 37.2 MHz signal to the output connector, J1. Variable resistor R20 is adjusted to suppress any 33 MHz carrier output from the mixer.

3-101. Digit Adder Mixer No. 2 (645-4141)

3-102. The Digit Adder Mixer No. 2 combines two input signals of 3.0 to 3.9 MHz and 36.9 to 37.2 MHz in an additive mixer and produces a 39.9 to 41.1 MHz output signal. The 3.0 to 3.9 MHz input at J3 is amplified by the tuned driver, Q1. Variable resistor R3 allows adjustment of the stage gain. The band-pass filter consisting of T1, L3, L4, and T2 processes the output of Q1 to reduce harmonic components. The secondary signal of T2 is applied to one input of the dual gate MOS FET mixer, Q3 and Q4. The 36.9 to 37.2 MHz input at J2 is filtered by L5 and amplified by the low-noise, tuned FET amplifier Q2 and L6. Capacitor C13 couples the resulting signal to IC1. Integrated circuit IC1 is a tuned limiter amplifier which produces a constant amplitude output. This output signal is applied to the other gates of Q3 and Q4 by the resonant circuit of L7 and C17. The resonant circuit consisting of L9 and C23 selects the desired sum frequency and C25 couples the 39.9 to 41.1 MHz signal to the output connector, J1. Variable resistor R20 is adjusted to suppress any 37 MHz carrier output from the mixer.

3-103. Digit Adder Mixer No. 2 (645-4142)

3-104. The Digit Adder Mixer Filter No. 2 processes frequencies from 40 to 41 MHz to remove any harmonic and modulation products. The parallel resonant circuits of L1 through L4 and C1 through C4 pass only frequencies between 39.9 to 41.1 MHz. This signal is then passed through a low-pass filter consisting of C5, L5, and C6, which rejects frequencies above 42 MHz.

3-105. Digit Adder Mixer Filter No. 3 (645-4143)

3-106. The Digit Adder Mixer Filter No. 3 processes frequencies from 40 to 41 MHz to remove harmonics and modulation products and provides a constant amplitude output signal. The 39.9 to 41.1 MHz input signal at J1 is amplified by the input driver Q1 and applied to IC1. Integrated circuit IC1 is a balanced differential amplifier, which provides sufficient gain of the input to drive the following band-pass filter of L4 through L7. This filter selects and passes only frequencies between 39.9 and 41.1 MHz. Capacitor C4 couples the filtered signal to the integrated circuit limiter, IC2. The constant amplitude output of IC2 is selected and filtered by L8 and L9 and applied to the output connector, J2. Variable resistor R11 allows adjustment of the output signal level at J2.

3-107. Oscillator Module (645-4185)

3-108. The Oscillator Module produces the output frequencies listed in Table 3-3 under the control of the 10

MHz frequency decade. The module circuitry consists of five separate LC oscillator circuits, each of which operates in the same manner. For this reason, only the 410 MHz oscillator circuit is described.

Table 3-3. OSCILLATOR MODULE FREQUENCIES

OUTPUT FREQUENCY	10 MHz FREQUENCY DECADE COMMAND
370 MHz	40 MHz
380 MHz	30 MHz
390 MHz	20 MHz
400 MHz	10 MHz
410 MHz	0 MHz

3-109. The 410 MHz oscillator is composed of an amplifier Q3, a resonant circuit A1, and the delay line 645-2055. Transistors Q1 and Q2 provide the necessary bias current for the oscillator whenever a +12 volt, zero 10 MHz frequency decade command exists. When the oscillator is not operating, CR1 isolates the oscillator circuitry from the common output line associated with J1 and J2. Variable resistor R3 and diode CR2 provide a bias control current to the ALC output connector J3. This control current is applied to the AGC Amplifier Module and establishes the synthesizer output level on the 1V RMS OUTPUT mode.

3-110. Input Mixer Module (645-4187)

3-111. The Input Mixer Module combines two input signals of 30 to 70 MHz and 370 to 410 MHz in a mixer which yields the sum and difference output frequencies. The low and high frequency inputs are provided in corresponding sets so that the difference frequency is always 340 MHz. The 30 to 70 MHz input at J1 is processed by the low-pass filter A1 to reduce harmonics and intermodulation products and applied to IC1. The 370 to 410 MHz input at J2 is directly applied to the other input of IC1. Integrated circuit IC1 is a double-balanced mixer which produces the sum and difference of the input frequencies, as well as the suppressed carriers and other modulation products, at J3. The following module connected to J3 selects only the desired 340 MHz difference frequency.

3-112. Three Stage Amplifier Modules (645-4186, -4188, -4195, -4196)

3-113. The Three Stage Amplifier Modules amplify frequencies from 340 to 421 MHz and produce a constant amplitude output. Since the operation of each module is essentially the same, only the 390 MHz Three Stage Amplifier Module is described.

3-114. The 370 to 410 MHz input at J1 is amplified by three tuned amplifier stages consisting of Q1 through Q3 and A1 through A3. Overall gain of the amplifiers is approximately 35 db with a low level input. However, a nominal input level has been established to produce a 7 db gain compression and provide a small amount of limiting which reduces input variations on the output. The output level is adjustable with R17. The resulting constant amplitude signal is then passed through the low-pass filter A4 to reduce harmonic products and applied to the output connector, J2.

3-115. First and Second Up Converter Modules (645-4189 and -4190)

3-116. The Converter Modules combine two separate input signals in an additive mixer and produce respective outputs at 380 to 381 MHz or 410 to 420 MHz. Since the operation of both modules is essentially the same, except for frequencies, only the First Up Converter Module is described.

3-117. The 39.9 to 41.1 MHz input at J1 is processed by the low-pass filter A1 and the double-tuned series circuit of L1 and L2 to reduce harmonic and side band products. Capacitors C4 and C5 couple the filtered signal to the balanced mixer, CR1 and CR2. The diodes also receive the 340 MHz input at J2 through the series resonant circuit consisting of T1, C6, and C7. Varactor diodes CR1 and CR2 and the series tuned circuit of T2 and C10 form a balanced mixer, which produces a sum output frequency of 379.9 to 381.1 MHz at J3. Variable resistor R11 adjusts the varactor bias to suppress any 340 MHz carrier output from the mixer.

3-118. Output Mixer Module (645-4191)

3-119. The Output Mixer Module combines two input signals of 370 to 410 MHz and 410 to 420 MHz in a subtractive mixer and produces a 0 to 50 MHz output. The 370 to 410 MHz input signal at J3 is applied through an attenuator composed of R1 through R3 to one input of IC1. The 410 to 420 MHz input at J2 is directly applied to the other input of IC1. Integrated circuit IC1 is a double-balanced mixer, which combines the two input signals. The 0 to 50 MHz difference frequency is selected by the low-pass filter of L1 and A1 and applied to the output connector, J1.

3-120. Output Amplifier Module (645-4193)

3-121. The Output Amplifier Module receives an input signal of 0 to 50 MHz and produces a low-level 0 to 100 kHz output and a high level 50 Hz to 50 MHz output. The amplitude of the 50 Hz to 50 MHz output is also sampled and the detected output made available for use with the Amplitude Control Module.

3-122. 0 TO 100 kHz OUTPUT. Input signals at J2 are applied through R2 to the input of IC1. Integrated circuit IC1 is an operational amplifier, which amplifies frequency signals from 0 to 100 kHz. Overall gain is equal to the ratio of R3 to R2 divided by R7 and the load impedance connected to J3. Variable resistor R9 provides an adjustable dc balance for IC1 so that the dc component of the output can be set to ground potential. Output signal level at J3 is 0.1 volts rms into 50 ohms for an input signal level of 19 millivolts at J2.

3-123. 50 Hz TO 50 MHz OUTPUT. Input signals at J2 are applied through R1 to the common-base tuned amplifier Q1. Transistor Q2 provides a high impedance-low current bias source for Q1. Variable resistor R17 provides adjustment of the base voltage for Q1 and subsequently the dc offset voltage at J1. Transistor Q3 is an emitter follower and provides a low impedance drive signal to the two stage voltage amplifiers, Q4 and Q5. Negative feedback from the collector of Q4 through R28 to the emitter of Q4 improves the frequency response of the amplifiers. Adjustable high frequency compensation is provided by C10. Variable resistor R31 adjust the gain of Q4 and subsequently the output signal level at J1. The collector signal of Q5 is coupled by C17 and C18 to the output amplifiers Q6 and Q7. Transistors Q6 and Q7 are parallel connected emitter power amplifiers, which produce a +13 dbm into 50 ohm output at J1. Resistors R43 and R44 provide a 50 ohm source impedance.

3-124. AMPLITUDE DETECTOR. The collector signal of Q5 is coupled by C15 to the amplitude detector circuit composed of CR1 through CR3, C16 and R38. The resulting charge on C16 is proportional to the amplitude of the 50 Hz to 50 MHz output signal and is applied to J4. This detected voltage signal is applied to the Amplitude Control Module for use in maintaining the preset output level in the ALC mode.

3-125. AGC Amplifier Module (645-4192)

3-126. The AGC Amplifier Module amplifies frequencies from 370 to 410 MHz and provides an output which has a level proportional to the total current from the Oscillator and Amplitude Control Modules. The 370 to 410 MHz input at J1 is amplified by three amplifier stages consisting of Q1 through Q3. The total current input at J2 and J3 controls the gain of Q3 and is nearly a linear function. Diode CR1 temperature compensates Q3. The output of Q3 is passed through the low-pass filter A4 to reduce harmonic products and is then applied to the output connector, J4.

3-127. Amplitude Control Module (645-4194)

3-128. The Amplitude Control Module functions to control the synthesizer output level on the ALC and EXT MOD modes. In the ALC mode, a reference established by the ALC LEVEL control is compared to an internal detector signal developed in the Output Amplifier Module and any difference amplified to maintain the output at the desired preset level. In the EXT MOD mode, the external modulation input signal is amplified and the resultant used to amplitude modulate the synthesizer output.

3-129. ALC MODE. The ALC mode is activated whenever a +12 volt gate is applied to the resistor at the base of Q10. The presence of this voltage turns on Q10 and the associated current sources of Q9 and Q11. Transistor Q9 supplies a constant current for the differential amplifier Q8, and Q11 supplies a reference current to the AGC output connector J3. A voltage proportional to the synthesizer output level is applied to J1, and a voltage established by the ALC LEVEL control is applied to J2. The differential amplifier Q8 compares the two voltages and amplifies any difference. The resulting outputs from Q8 are then summed in the base circuits of Q1 and Q5 and add or subtract from the reference current established at J3 by Q11. Transistor Q6 inverts the output of Q1, thus eliminating one phase of the differential amplifier and provides a single ended output. The current furnished to J3 is then used to alter the synthesizer output level until the preset level established with the ALC LEVEL control is obtained. Frequency range of this feature is 20 kHz to 50 MHz. The diode CR6 and associated resistors clamp the output at J3 and protect the transistor circuitry in the AGC Amplifier Module.

3-130. EXT MOD MODE. The EXT MOD Mode is activated whenever a +12 volt gate is applied to the resistor at the base of Q4. The presence of this voltage turns on Q4 and the associated current sources of Q3 and Q7. Transistor Q3 supplies a constant current for the differential amplifier Q2, and Q7 supplies a reference current to the ALC output connector, J3. Variable resistor R16 allows adjustment of this reference current. The external modulation input signal at J4 is amplified by the differential amplifier Q2 and then summed and amplified by Q1, Q5, and Q6. The resulting output signal adds or subtracts from the reference current established by Q7, which in turn amplitude modulates the synthesizer output. Variable resistor R1 adjusts the gain of Q2 and subsequently the modulation level. Frequency range of the amplitude modulation circuitry is dc to 10 kHz.

3-131. Power Supply (645-4063)

3-132. The Power Supply consists of three low-ripple power supplies that produce output voltages of +5 and ±12 volts dc. Current limit circuitry is included in each power supply and protects the regulators should a continuous short circuit occur.

3-133. The input power transformer T1 receives input ac power through the RFI line filter, fuses F1 and F2, and the LINE VOLTS switch S1. The primary winding of T1 is constructed to receive power line voltages of 100, 115, 200, and 230 volts ac. LINE VOLTS switch S1 provides the necessary circuit connections at the primary of T1. Three windings comprise the secondary of T1 and supply the bridge rectifiers CR1, CR12, and CR23 with the required ac voltages.

3-134. +5 VOLT POWER SUPPLY. The unregulated dc voltage for the +5 volt power supply is produced by the diode bridge CR23 and diodes CR24 and CR25. The diode bridge plus output drives the series-pass element Q5, and the output of CR24 and CR25 drives the regulator circuitry consisting of Q15 through Q21. Current through CR26 and CR27 turns on the constant current source Q17, which provides operating current to transistors Q15, Q19, and Q20. Transistor Q16 provides a high impedance source at the base of Q17 and attenuates any ripple to the microvolt level. The reference voltage for the regulator is obtained from CR28, which receives operating voltage from the +12 volt supply. The differential amplifier consisting of Q20 and Q21 compares the reference voltage from CR28 to a sample of the +5 volt output developed across the divider composed of R64, R65, and R66. Any difference is amplified and increases or decreases the condition of Q19 and Q5 to maintain the specified +5 volt dc output. Variable resistor R65 allows adjustment of the regulator output voltage.

3-135. Current overloads are prevented from harming the regulator and series-pass elements by the current limiter, Q15. Under normal operating conditions this transistor is not conducting because of the bias voltage developed by resistors R51 through R55. However, if the output current of the regulator, which is passed through R53 and R55, exceeds approximately 2.5 amperes, transistor Q15 conducts and bypasses some of the base current normally supplied to Q19 from Q17. This reduction in base current of Q19 decreases its conduction and the series-pass transistor Q5 which, in turn, reduces the regulator output. As the regulator output decreases, the bias voltage developed by R51 through R55 maintains conduction of Q15 and results in "fold-back" current limiting of the regulator output. A example of "fold-back" current limiting is shown in Figure 3-13.

NOTE!

Since the operation of the plus and minus 12 volt power supplies is the same, only the +12 volt power supply is described.

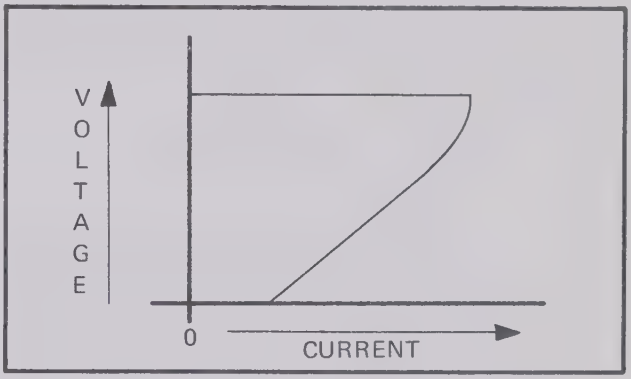


Figure 3-13. FOLDBACK CURRENT LIMITING

3-136. +12 VOLT POWER SUPPLY. The +12 volt power supply consists of two cascaded, proportionally controlled series-pass regulators. Each regulator has its series-pass element mounted on an external heat sink. The unregulated dc output of CR12 is filtered by C9 and applied to the preregulator composed of Q8, IC3, Q10, and Q1. Current through CR16, CR17, and R32 turns on the constant current source Q8, which provides current to the comparator amplifier IC3 and the series-pass driver Q8. Initial turn-on of IC3 is ensured by the start-up circuit composed of R26, CR13 and CR14. Upon application of voltage to the preregulator, CR13 conducts and applies a reference voltage established by CR14 to the comparator amplifier, IC3. This reference voltage and the current supplied by Q8 brings IC3 into conduction which, in turn, brings the series-pass driver Q10 and the series-pass element Q1 into conduction. As the preregulator output approaches the nominal +17 volt output level, current through R31 and zener CR15 establishes a reference voltage for IC3 which is slightly higher than that of CR14. Diode CR13 is cut-off by this action and disconnects the start-up circuitry from the regulator. The comparison amplifier IC3 then compares the reference voltage established by CR15 to a sample of the preregulator output developed across the divider composed of R33 through R35. Conduction of IC3 increases or decreases the base current of Q10 and the conduction of the series-pass element Q1 is altered to maintain the specified +17 volt output. Variable resistor R34 allows adjustment of the preregulator output voltage.

3-137. The preregulator output is applied to the output regulator composed of Q11, Q12, Q14, IC4 and the series-pass element, Q2. Circuit operation of this regulator is identical to that of the preregulator, except for the current limiter Q11, and produces an output voltage of +12 volts dc. Variable resistor R49 allows adjustment of the output voltage. Transistor Q11 and associated resistors R37 through R39 form a current limiter, which prevents current overloads above 2.5 amperes from harming the regulator and series-pass elements. Operation of this current limiter is identical to that of the +5 volt power supply described in paragraph 3-135.

3-138. Control Circuitry (645-4062)

3-139. The Control Circuitry located on the 645-4062 assembly produces control signals for the synthesizer circuitry. This assembly also provides independent or simultaneous selection of the remote control functions. The schematic diagram for this assembly is located on the System DC Schematic, Drawing No. 645-1002 (1 of 2).

3-140. Control of the synthesizer output freqeuncy is accomplished using the Frequency Dials S1 through S10 or by +12 volt remote control commands from the REMOTE INPUT connector, J1. When the FREQUENCY SELECTION switch S16 is placed to the LOCAL position, +12 vdc is applied to S1 through S10 and control is accomplished from the front panel Frequency Dials. When S16 is placed to the REMOTE position, +12 vdc is removed from S1 through S10 and applied to terminal 25 of the REMOTE INPUT connector, J1. Remote inputs at J1 then determine the synthesizer output frequency. Diodes CR10 through CR19 isolate S1 through S10 from the remote control inputs.

3-141. Selection of the search frequency decade is provided by the DECADE SELECTOR S15 and the inverting amplifiers Q1 through Q8. When S15 is placed to the OFF position, the positive emitter voltage of Q1 through Q8 turns each transistor on, and a +11.5 vdc control signal is applied to the respective 33 MHz gates in the A4A15 Gate Matrix Module. Diodes CR1 through CR8 prevent the base voltages of Q1 through Q8 from reaching the Gate Matrix Module search gates. As a result, zero volt control signals are applied to the search gates. Selection of a particular search decade with S15 applies a +12 volt control signal to the associated search gate, inverting amplifier of Q1 through Q8, and the frequency decade indicator lamp of DS2 through DS9. The inverting amplifier is turned off and, in turn, applies a zero volt control signal to the corresponding 33 MHz gate in the Gate Matrix Module. When the DECADE SELECTOR is placed to the REMote position, the +12 volt control signal is applied to terminal 121 of the REMOTE INPUT connector. Remote inputs from J1 are then used to control the inverting amplifiers and associated search gates.

3-142. The output level of the synthesizer is determined by the setting of the OUTPUT control, S11. When this control is set to the EXT AM position, a +12 volt control signal is applied to the A5A10 Amplitude Control Module and activates the amplitude modulation feature. When S11 is set to the ALC position, a +12 volt control signal is applied to another input of the Amplitude Control Module. The ALC feature is activated at this time and the output level of the synthesizer is determined by the setting of the ALC LEVEL control, R29. When S11 is set to the 1V RMS position, the output level of the synthesizer is preset to a 1.0 volt rms into 50 ohm level. Remote control of the OUTPUT mode is also possible when this control is set to the 1V RMS position. Remote inputs are applied to terminals 123 and 124 of J1.

3-143. The DIGIT INTERPOLATOR Dial of R15 produces a −10 to +10 vdc search control voltage. Resistor R14 and R16 are connected to respective −12 and +12 vdc potentials and are adjusted to establish the −10 and +10 end limits of R15. The wiper voltage of R15 is applied to the Marker Control output connector J3 and the SEARCH DIGIT INTERPOLATOR MODE switch S13A and C. When S13 is placed to the LOCAL position, search voltage from R15 is applied to the Search Oscillator output connector J2 and terminal 10 of IC3. Integrated circuit IC3 is a power amplifier and produces an output across the parallel resistive divider of R23 through R27. A reduced amplitude replica of the search voltage is taken from the junction of R23 and R24 and applied to the Sweep Analog output connector, J1. When S13 is placed to the REMOTE position, the Remote Search Input at J3 is applied to the Search Oscillator output connector, J2. The Sweep Analog output at J1 is a reduced amplitude replica of this voltage. When S13 is placed to the SWEEP position, the Search Oscillator and Sweep Analog outputs are derived from the sweep generator consisting of IC1, IC2, and IC3.

3-144. Integrated circuits IC1, IC2, and IC3 form a sweep generator which produces 12 preset triangular sweep voltages. The heart of the sweep generator consists of the operational integrator IC2 and the timing components of C6 through C8 and R6 through R11, which are selected by the SWEEP TIME-SEC switch, S12. When the SEARCH DIGIT INTERPOLATOR MODE switch is placed to the SWEEP position, the sweep voltage at terminal 6 of IC2 is applied through S13B to terminal 11 of IC3. The amplified output at terminal 3 of IC3 is developed across the resistive divider consisting of R23 through R27. A reduced amplitude replica at the junction of R23 and R24 is applied to the Sweep Analog output connector J1 and three different levels are available from the SWEEP WIDTH switch, S14. The selected X.2, X.5, or X1 sweep voltage level is then passed through S13C and applied to the Search Oscillator connector, J2. A full-scale sweep signal is also fed back to terminal 2 of the comparator amplifier, IC1. When this voltage exceeds the voltage present at terminal 3 of IC1, the comparator amplifier reverses its output voltage at terminal 6. This action terminates the sweep voltage change and causes the operational integrator circuit to charge in the opposite direction, thus producing a traingular sweep voltage signal. Variable resistor R3 allows setting of the sweep signal terminating points.

SECTION 4
Maintenance

4-1. INTRODUCTION

4-2. This section of the manual contains information necessary for complete servicing and maintenance of the Model 645A. The information is arranged under headings of "SERVICE INFORMATION, MAINTENANCE ACCESS, GENERAL MAINTENANCE, SYNTHESIZER ALIGNMENT, MODULE ALIGNMENT, HARMONIC CHECKS, and TROUBLESHOOTING". A list of the test equipment required to service the synthesizer is contained in Table 4-1. If the recommended equipment is not available, substitute equipment having equivalent or superior specifications can be used.

4-3. SERVICE INFORMATION

4-4. Each synthesizer manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. Complete warranty information is given in the WARRANTY page located at the front of this manual.

4-5. MAINTENANCE ACCESS

4-6. Major Section Access

4-7. To gain access to the major sections of the synthesizer, proceed as follows:

a. De-energize the Model 645A.

b. Remove the top and bottom dust covers and front and rear trim strips. Access is now provided to the major sections of the synthesizer which are illustrated in Figure 4-1.

c. Locate the Input Tray Section and unlock the fasteners that secure this assembly to the chassis.

d. Lift the Input Tray Section away from the chassis until the support braces latch. The assembly will now remain in the open position as shown in Figure 4-2.

e. Locate the UHF Tray Section and unlock the fasteners that secure this assembly to the chassis.

f. Lift the UHF Tray Section away from the chassis until the support braces latch. The assembly will now remain in the open position as shown in Figure 4-2.

4-8. Module Removal

4-9. To remove a module, proceed as follows:

a. Locate the module using the decal contained on the inside of the dust covers.

b. Disconnect the power leads and control lines from the feed-thru terminals on the module.

c. Disconnect the rf cables from the module.

d. Remove the screws that attach the module to the chassis and then remove the module.

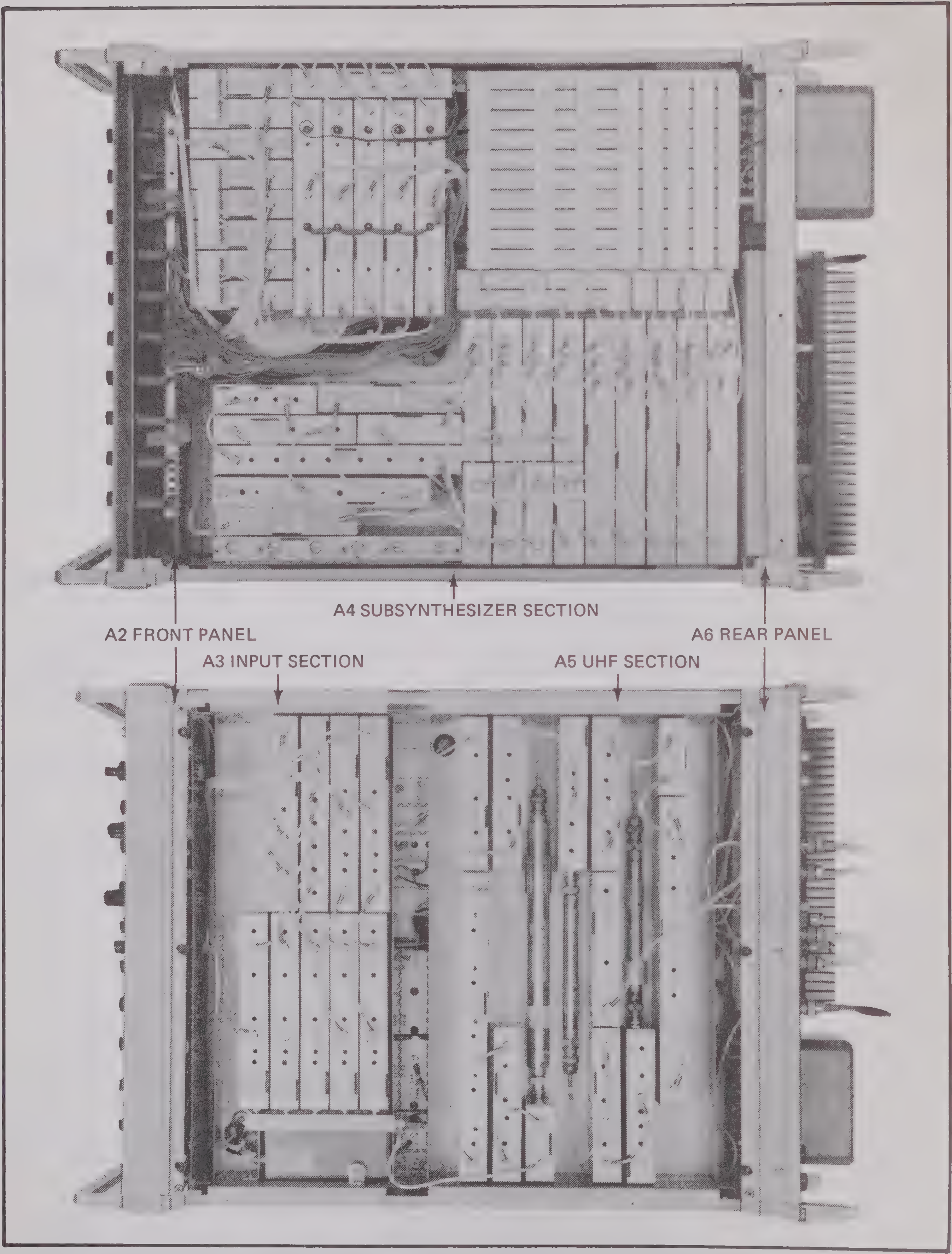

A4 SUBSYNTHESIZER SECTION
A2 FRONT PANEL
A6 REAR PANEL
A3 INPUT SECTION
A5 UHF SECTION

Figure 4-1. MAJOR SYNTHESIZER SECTIONS

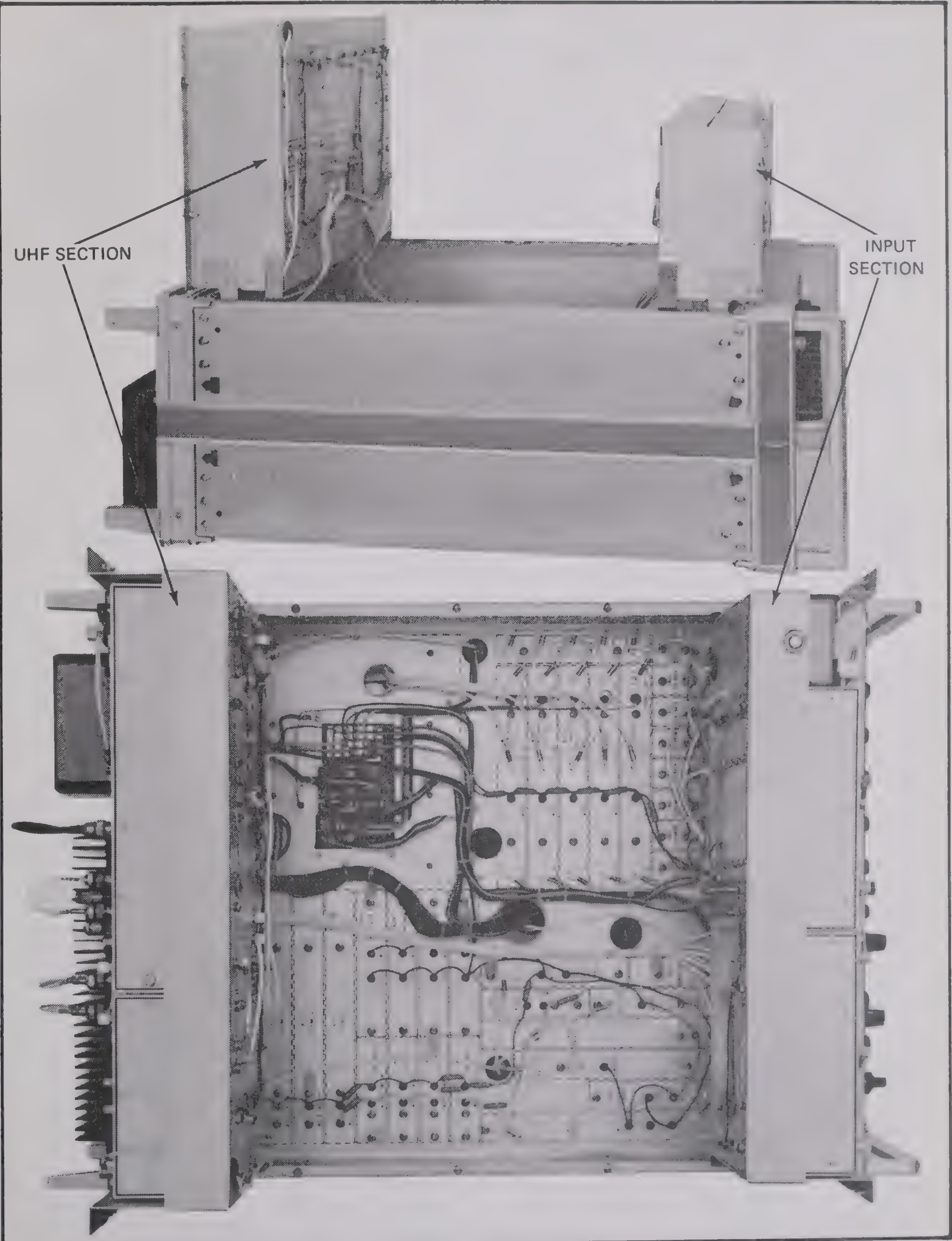

UHF SECTION
INPUT SECTION

Figure 4-2. INPUT AND UHF SECTIONS–OPEN

Table 4-1. REQUIRED TEST EQUIPMENT

EQUIPMENT NOMENCLATURE	RECOMMENDED EQUIPMENT	TEST FUNCTION
Frequency Counter Frequency Converter	H.P. Model 5245M H.P. Model 5253B	Synthesizer Alignment Module Alignment
RF Voltmeter	H.P. 411 H.P. 400D	Synthesizer Alignment Module Alignment
Oscilloscope	Tektronix Model 454	Synthesizer Alignment Module Alignment
Spectrum Analyzer	H.P. Model 8551B/851B	Synthesizer Harmonic Checks ; Module Alignment
Loads	Four 50-ohm loads	Synthesizer Alignment Module Alignment
DC Differential Voltmeter	John Fluke Model 895A	Synthesizer Alignment Module Alignment
Sweep Analyzer:		Module Alignment
Oscilloscope	Alfred Model 8000	
Analyzer	Alfred Model 7051	
Crystal Detector	Alfred Model 1403	
Sweep Generator	Texscan Model V5-80	
DC Voltage Calibrator	John Fluke Model 332B	Synthesizer Alignment Module Alignment
Power Supplies:		Module Alignment
+5 vdc	Harrison Lab. Model 865B	
±12 vdc	Acoptan Model LL	
120 db, 10 db Step Attenuator	H.P. 3550	Module Alignment
Field Intensity Meter:	NF-105	Module Alignment
Tuning Units:		
20 - 200 MHz	T1/NF-105	
200 - 400 MHz	T2/NF-105	
400 - 1000 MHz	T3/NF-105	
Signal Generators:		Module Alignment
50 kHz - 65 MHz	H.P. Model 606	
10 MHz - 480 MHz	H.P. Model 608C (2)	
Frequency Comparator	John Fluke Model 103A	Synthesizer Alignment

4-10. Module Installation

4-11. To install a module, proceed as follows:

a. Install the module in the correct position indicated by the decal on the inside of the dust cover.

b. Install the screws that attach the module to the chassis.

c. Solder the appropriate power leads to the feed-thru terminals on the module. The power leads are No. 22 wire and have the following color code:

RED = +12V
YELLOW = +5V
VIOLET = –12V

d. Solder the appropriate control lines to the feed-thru terminals on the module. The control lines are No. 26 "Spectra Strip" wires. Color codes are given on the System DC Schematic, Drawing No. 645-1002.

e. Connect the rf cables to the appropriate "J" connectors on the module. The Block Diagram, Drawing No. 645-1500, contains rf cable connection information.

4-12. GENERAL MAINTENANCE

4-13. Cleaning

4-14. The Model 645A is completely enclosed and will require only occasional exterior cleaning using a cloth moistened with anhyrdous ethyl alcohol or Freon TF Degreaser (Miller-Stephenson Chemical Co., Inc.) If either of these cleaning agents are not readily available, soap and water applied sparingly to a cloth can be used.

4-15. Fuse Replacement

4-16. There are two fuses located in bayonent fuseholders on the rear panel. These fuses protect the ac power circuitry from overloads. When replacing these fuses, use the following values:

100 or 115 VAC INPUT	200 or 230 VAC INPUT
1A, SLO-BLO	0.5A, SLO-BLO

4-17. Lamp Replacement

4-18. Search Decade Indicator Lamps are located behind the upper portion of the synthesizer front panel. These lamps are accessible from the top of the synthesizer after removing the top dust cover and top front trim strip. Removal and replacement of the lamps is easily accomplished without special tools. If replacement is necessary, use GE 709 lamps, John Fluke Part No. 192120.

4-19. SYNTHESIZER ALIGNMENT

4-20. Introduction

4-21. The Model 645A was completely tested and aligned before leaving the factory, and realignment should not be necessary. However, if corrective maintenance is performed on any of the assemblies contained in the synthesizer, the overall synthesizer performance should be checked using the following alignment procedures. Alignment procedures for each module assembly are contained in paragraphs 4-39 through 4-91.

4-22. An Accessory Kit is furnished with the synthesizer to facilitate rack installation, remote operation, and servicing. Special tools and fixtures provided for servicing are illustrated in Figure 4-3.

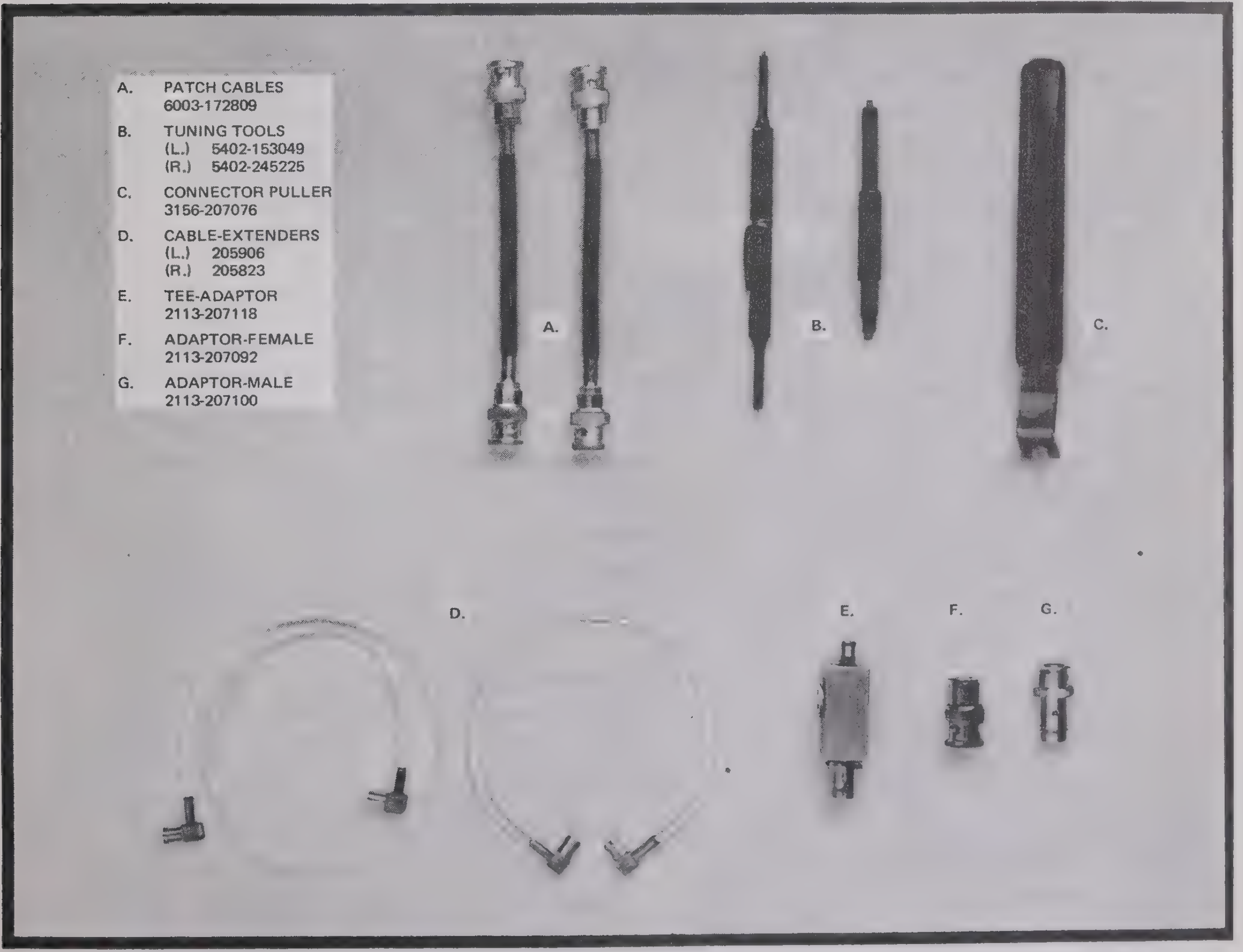

A. PATCH CABLES
6003-172809
B. TUNING TOOLS
(L.) 5402-153049
(R.) 5402-245225
C. CONNECTOR PULLER
3156-207076
D. CABLE-EXTENDERS
(L.) 205906
(R.) 205823
E. TEE-ADAPTOR
2113-207118
F. ADAPTOR-FEMALE
2113-207092
G. ADAPTOR-MALE
2113-207100

Figure 4-3. ACCESSORY KIT COMPONENTS

4-23. Preliminary Alignment Procedures

4-24. Before attempting to align the synthesizer, perform the following steps:

a. Perform the Major Section Access procedures contained in paragraph 4-6.

b. Perform the Initial Operating Procedures contained in Section II, paragraph 2-10.

4-25. Power Supply Checks

a. Measure the voltage present at the orange power lead terminal with respect to the chassis using a dc differentail voltmeter. The voltage should be +12, ±0.1 volts dc.

b. Connect the voltmeter input to the blue power lead terminal. The voltage should be –12, ±0.1 volts dc.

c. Connect the voltmeter input to the yellow power lead terminal. The voltage should be +5, ±0.1 volts dc.

d. Disconnect the voltmeter from the synthesizer.

4-26. UHF Section Frequency Alignment

a. Disconnect cable number 121 from A5A4J2.

b. Connect the input of a frequency counter to A5A4J2.

c. Perform the frequency checks and adjustments contained in Table 4-2. Allow at least 30 seconds at each Frequency Dial setting before attempting any measurement or adjustment.

d. Disconnect the frequency counter from the synthesizer and reconnect cable number 121 to A5A4J2.

4-27. Input Section Level Alignment

a. Disconnect cable number 120 from A5A4J1.

b. Connect the input of an rf voltmeter and a 50-ohm load to cable number 120.

c. Perform the level checks and adjustments contained in Table 4-3.

d. Disconnect the rf voltmeter and 50-ohm load from cable number 120.

Table 4-2. UHF SECTION FREQUENCY CHECKS

FREQUENCY DIAL SETTINGS	A5A4J2 FREQUENCY (±0.1 MHz)	ADJUSTMENT (A5A1 MODULE)
05000000.00	340 MHz	A1A1
15000000.00	340 MHz	A1A2
25000000.00	340 MHz	A1A3
35000000.00	340 MHz	A1A4
45000000.00	340 MHz	A1A5

Table 4-3. INPUT SECTION LEVEL CHECKS

FREQUENCY DIAL SETTINGS	CABLE NO. 120 SIGNAL LEVEL	ADJUSTMENT (A3 INPUT SECTION)
05000000.00	–23 dbm	A3A2R12
15000000.00	–23 dbm	A3A3R12
25000000.00	–23 dbm	A3A4R12
35000000.00	–23 dbm	A3A5R12
45000000.00	–23 dbm	A3A6R12

e. Connect cable number 120 to A5A4J1.

4-28. UHF and Subsynthesizer Drive Level Adjustment

a. Disconnect cable number 122 from A5A9J1.

b. Connect the input of an rf voltmeter and a 50-ohm load to cable number 122.

c. Adjust A5A4A3 for maximum rms voltage at cable number 122.

d. Adjust A5A8C6 for a maximum rms voltage at cable number 122.

e. Alternately step the 10 and 100 kHz Frequency Dials between 00 and 99 and record the rf voltmeter indication.

f. Adjust A5A8C10 to equalize the levels recorded in step e.

g. Adjust A4A20R11 for a signal level of –16 ±1 dbm at cable number 122.

h. Disconnect the rf voltmeter and 50-ohm load from cable number 122.

i. Connect cable number 122 to A5A9J1.

j. Disconnect cable number 124 from A5A11J1.

k. Connect the rf voltmeter input and a 50-ohm load to cable number 124.

l. Set the Frequency Dials to 05500000.00 and adjust A5A9A3 for maximum rms voltage at cable number 124.

m. Adjust A5A12C6 for maximum rms voltage at cable number 124.

n. Alternately step the 100 kHz and 1 MHz Frequency Dials between 00 and 99 and record the rf voltmeter indication.

o. Adjust A5A12C10 to equalize the levels recorded in step n. The resulting signal level should be –17 ±2 dbm. Adjustment of this signal level is accomplished by aligning the A4A9 30 - 39 MHz Gate module using the procedures contained in paragraph 4-59. The correct output level of the A4A9 module is –8 ±0.5 dbm. If this level is correct, adjust A5A9R16 for –17 ±2 dbm at cable number 124. Ensure that the signal level at A5A9J2 is +7.5 ±1.5 dbm after adjusting A5A9-R16.

p. Disconnect the rf voltmeter and 50-ohm load from cable number 124.

q. Connect cable number 124 to A5A11J1.

r. Disconnect cable number 125 from A5A15J2.

s. Connect the rf voltmeter input and a 50-ohm load to cable number 125. Use a 50-ohm "T" adapter furnished with rf voltmeter.

t. Set the Frequency Dials to 00000000.00 and 09900000.00 and record the rf voltmeter indication.

u. Adjust A5A11A3 to equalize the levels recorded in step t.

v. Adjust A5A11R16 for an rf voltmeter indication of +7.5 ±0.5 dbm.

w. Disconnect the rf voltmeter and 50-ohm "T" adapter from cable number 125.

x. Connect cable number 125 to A5A15J2.

4-29. 50 Hz - 50 MHz Output Level Alignment

a. Connect the input of an rf voltmeter, using a 50-ohm "T" adapter, to the 50 Hz - 50 MHz SYNTHESIZER OUTPUT connector. Ensure this output is terminated into 50-ohms.

b. Set the OUTPUT control to 1V RMS.

c. Perform the output level adjustment contained in Table 4-4.

Table 4-4. 50 Hz - 50 MHz OUTPUT LEVEL ADJUSTMENTS

FREQUENCY DIAL SETTINGS	ADJUSTMENT (A5A1 MODULE)	OUTPUT LEVEL (50 Hz - 50 MHz)
05000000.00	R13	1.0 ±0.01 vrms
15000000.00	R15	1.0 ±0.01 vrms
25000000.00	R24	1.0 ±0.01 vrms
35000000.00	R33	1.0 ±0.01 vrms
45000000.00	R42	1.0 ±0.01 vrms

d. Set the OUTPUT control to ALC and the Frequency Dials to 25000000.00.

e. Rotate the ALC LEVEL control fully counter clockwise, observing that the 50 Hz - 50 MHz output level is 0.10 to 0.25 volts rms.

f. Rotate the ALC LEVEL control fully clockwise, observing that the 50 Hz - 50 MHz output level is 1.05 to 1.15 volts rms.

g. Set the OUTPUT control to EXT AM.

h. Adjust A5A10R16 for a 0.67 volt rms level at the 50 Hz - 50 MHz output connector.

i. Set the Frequency Dials to the following settings, observing that the following 50 Hz - 50 MHz output level is within ±0.05 volts of its assigned level:

5 MHz — 0.12 volts rms
15 MHz — 0.67 volts rms
25 MHz — 0.67 volts rms
35 MHz — 0.70 volts rms
45 MHz — 0.72 volts rms

j. Set the Frequency Dials to 25000000.00.

k. Disconnect the rf voltmeter and 50-ohm “T” adapter from the 50 Hz - 50 MHz output connector.

l. Connect the input of an oscilloscope to the 50 Hz - 50 MHz output connector. Ensure that this output is terminated into a 50-ohm load.

m. Adjust the oscilloscope vertical positioning and gain controls to provide a half-scale display.

n. Apply a 1 kHz ±10% signal having a level of 1.0 ±0.1 volts rms to the EXT AM input connector.

o. Adjust A5A10R1 for a 50% modulation pattern on the oscilloscope display.

p. Set the OUTPUT control to 1V RMS and disconnect the oscilliscope from the synthesizer.

4-30. Search Digit Interpolator Dial Alignment

a. Connect the input of a dc differential voltmeter to TP3 on the front panel PCB and its common lead to TP4.

b. Set the DIGIT INTERPOLATOR Dial to +1.0 and adjust R16 for 10 ±0.02 volts dc at TP3.

c. Set the DIGIT INTERPOLATOR Dial to −1.0 and adjust R14 for −10 ±0.2 volts dc at TP3.

d. Repeat steps b and c until the specified results are obtained.

e. Set the DIGIT INTERPOLATOR Dial to 0. The voltage at TP3 should be 0 ±0.05 volts dc.

f. Disconnect the voltmeter from the synthesizer.

4-31. Internal Frequency Standard Alignment

a. Remove the cover from the adjustment access hole on the A3A1 Internal Frequency Standard.

b. Connect a frequency comparator between the house frequency standard and the 5 MHz SYNTHESIZER OUTPUT connector.

c. Rotate the A3A1 Internal Frequency Standard adjustment for a frequency comparator $\Delta f/f$ of $<1 \times 10^{-8}$.

d. Disconnect the frequency comparator from the synthesizer and replace the A3A1 adjustment cover.

4-32. Synthesis Checks

a. Apply a 5 MHz drive signal from a house frequency standard to the 5 MHz SYNTHESIZER INPUT connector.

b. Disconnect cable number 109 from A4A32J2.

c. Connect the input of the frequency counter to cable number 109. The frequency counter must be gated with a signal derived from the external frequency standard.

d. Set the Frequency Dials to all zeros. The frequency counter should indicate 4.0 MHz, ±1.0 Hz.

e. Set the DIGIT INTERPOLATOR Dial to +1.0 and perform the search decade checks contained in Table 4-5. Also observe that the appropriate search decade indicator lamp illuminates.

f. Set the DECADE SELECTOR to OFF.

Table 4-5. SEARCH DECADE CHECKS

DECADE SELECTOR SETTING	FREQUENCY COUNTER INDICATION (MHz)
.01	4.000010 ±1.0 Hz
.1	4.000100 ±2.0 Hz
1	4.001000 ± 20 Hz
10	4.010000 ± 200 Hz

g. Perform the synthesis checks contained in Table 4-6. Frequency counter tolerances are ±1.0 Hz.

Table 4-6. SYNTHESIS CHECKS

FREQUENCY DIAL SETTINGS	FREQUENCY COUNTER INDICATION (MHz)
00000012.34	4.012340
00000011.11	4.011110
00000022.22	4.022220
00000033.33	4.033330
00000044.44	4.044440
00000055.55	4.055550
00000066.66	4.066660
00000077.77	4.077770
00000088.88	4.088880
00000099.99	4.099990

h. Disconnect the frequency counter input from cable number 109.

i. Connect cable number 109 to A4A32J2.

j. Connect the frequency counter input to the 50 Hz - 50 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load.

k. Set the Frequency Dials to all zeros, observing that the frequency counter indicates zero ±1.0 Hz.

l. Perform the search checks contained in Table 4-7. Ensure that the DIGIT INTERPOLATOR Dial is set to +1.0 during these checks. Also observe that the appropriate search decade indicator lamp illuminates.

Table 4-7. SEARCH CHECKS

DECADE SELECTOR SETTING	FREQUENCY COUNTER INDICATION (MHz)
100	00.000100 ±2 Hz
1K	00.001000 ±20 Hz
10K	00.010000 ±200 Hz
100K	00.100000 ±2 kHz

m. Set the DECADE SELECTOR to OFF and perform the output synthesis checks contained in Table 4-8. Frequency counter tolerances are ±10 Hz.

Table 4-8. OUTPUT SYNTHESIS CHECKS

FREQUENCY DIAL SETTINGS	FREQUENCY COUNTER INDICATION (MHz)
12345600.00	12.3456
11111100.00	11.11110
22222200.00	22.22220
33333300.00	33.33330
44444400.00	44.44440
05555500.00	5.55550
06666600.00	6.66660
07777700.00	7.77770
08888800.00	8.99990
09999900.00	9.99990

4-33. Search Checks and Sweep Alignment

a. Set the Frequency Dials to 03000000.00 and the DECADE SELECTOR to 100K.

b. Perform the DIGIT INTERPOLATOR Dial checks contained in Table 4-9. Frequency counter tolerances are ±2.0 kHz.

Table 4-9. DIGIT INTERPOLATOR DIAL CHECKS

DIGIT INTERPOLATOR DIAL SETTING	FREQUENCY COUNTER INDICATION (MHz)
+1.0	3.100
+0.5	3.050
0	3.000
–0.5	2.950
–1.0	2.900

c. Set the SEARCH DIGIT INTERPOLATOR MODE to SWEEP, the SWEEP TIME-SEC to 20 and the SWEEP WIDTH to X1.

d. Adjust R3 on the front panel PCB until the synthesizer output frequency sweeps between 2.9 to 3.1 MHz. End limit frequency tolerance is ±2.0 kHz.

e. Connect the input of an oscilloscope to the SWEEP ANALOG output connector, observing that a triangular waveform having a peak-to-peak amplitude of 2, ±0.5 volts is available.

f. Set the SEARCH DIGIT INTERPOLATOR Mode to REMOTE.

g. Apply +10 volts dc to the REMOTE SEARCH input connector, observing that the synthesizer output frequency is 3.100 MHz, ±2.0 kHz.

h. Set the SEARCH DIGIT INTERPOLATOR MODE to LOCAL and the DECADE SELECTOR to OFF.

i. Disconnect the test equipment from the synthesizer.

3-34. Fixed Output Alignment

a. Connect the input of a frequency counter to the 5 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. The frequency counter must be gated by a signal derived from the synthesizer drive source.

b. Observe that the frequency counter indicates 5.0 MHz, ± one digit.

c. Connect the frequency counter input to the 10 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. The frequency should indicate 10 MHz, ± one digit.

d. Disconnect the frequency counter from the synthesizer.

e. Connect the input of an rf voltmeter to the 5 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load.

f. Adjust A3A7R17 for an rf voltmeter indication of 1.0 volt rms, ±1 db.

g. Connect the rf voltmeter input to the 10 MHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load.

h. Adjust A3A8R2 for an rf voltmeter indication of 1.0 volt rms, ±1 db.

i. Disconnect the rf voltmeter from the synthesizer.

4-35. 0 - 100 kHz Output Level Check

a. Connect the input of an rms voltmeter to the 0 - 100 kHz SYNTHESIZER OUTPUT connector and previously installed 50-ohm load. Ensure that the OUTPUT control is set to 1V RMS.

b. Set the Frequency Dials to the following settings, observing that the 0 - 100 kHz output is 0.1, ±0.02 volts rms:

FREQUENCY DIAL SETTINGS

00000100.00
00001000.00
00010000.00
00100000.00

c. Disconnect the rms voltmeter from the synthesizer.

4-36. ALC Level Check

a. Connect the input of an rf voltmeter, using a 50-ohm "T" adapter, to the 50 Hz - 50 MHz SYNTHESIZER OUTPUT connector. Ensure that this output is terminated into 50-ohms.

b. Set the Frequency Dials to 01000000.00.

c. Set the OUTPUT control to ALC and adjust the ALC LEVEL control for an rf voltmeter indication of 1.0 ±0.05 volts rms.

d. Set the Frequency Dials to the following settings, observing that the rf voltmeter indicates 1.0, ±0.05 volts rms:

FREQUENCY DIAL SETTINGS

10000000.00
49900000.00

e. Disconnect the rf voltmeter and 50-ohm "T" adapter from the synthesizer.

4-37. Remote Operation Checks

NOTE!

Prior to performing these checks, it is essential that the synthesizer operation be completely verified using LOCAL front panel control.

a. Connect the remote control panel to the REMOTE INPUT connector on the synthesizer.

b. Apply the remote control panel Digit Interpolator Dial output through a BNC cable to the REMOTE SEARCH input connector on the synthesizer.

c. Set the Model 645A controls to the following positions:

SEARCH DIGIT INTERPOLATOR MODE	REMOTE
FREQUENCY CONTROL	REMOTE
DECADE SELECTOR	REMOTE
OUTPUT	1V RMS

d. Set the remote control panel Decade Selector to each .01 through 100k position, observing that the corresponding search decade indicator lamp on the Model 645A front panel illuminates.

e. Set the remote control panel Decade Selector to OFF.

f. Connect the input of a frequency counter to the 50 Hz - 50 MHz output connector and previously installed 50-ohm load.

g. Perform the remote output synthesis checks contained in Table 4-10. Frequency counter tolerances are ±10 Hz.

Table 4-10. REMOTE OUTPUT SYNTHESIS CHECKS

REMOTE PANEL FREQUENCY DIAL SETTINGS	FREQUENCY COUNTER INDICATION (MHZ)
11111100.00	11.11110
22222200.00	22.22220
33333300.00	33.33330
44444400.00	44.44440
45555500.00	45.55550
46666600.00	46.66660
47777700.00	47.77770
48888800.00	48.88880
49999900.00	49.99990

h. Disconnect frequency counter from the synthesizer.

i. Connect the input of an rf voltmeter, using a 50-ohm "T" adapter, to the 50 Hz - 50 MHz connector. Ensure that this output is terminated into 50-ohms. The rf voltmeter should indicate an output level of 1.0 volt rms, ±1 db.

j. Set the remote control panel Output control to ALC and the Frequency Dials to 25000000.00.

k. Rotate the synthesizer ALC LEVEL control throughout its adjustment range, observing that the 50 Hz - 50 MHz output level is adjustable from 0.2 to 1.1 volts rms.

l. Set the remote control panel Output control to EXT AM, observing that the 50 Hz - 50 MHz output level is 0.67 ±0.05 volts rms.

m. Disconnect the rf voltmeter and 50-ohm "T" adapter from the synthesizer.

n. Set the Model 645A controls to the following positions:

SEARCH DIGIT INTERPOLATOR MODE	LOCAL
FREQUENCY CONTROL	LOCAL
DECADE SELECTOR	OFF
OUTPUT	1V RMS

4-38. Alignment of the synthesizer is now complete. However, the Harmonic checks contained in paragraphs 4-92 should be performed.

4-39. MODULE ALIGNMENT

4-40. Introduction

4-41. Alignment or test procedures for each module assembly are contained in the following paragraphs. Refer to paragraphs 4-8 and 4-10 for module removal and installation procedures. When module alignment or testing is completed, overall performance of the synthesizer should be rechecked using the Synthesizer Alignment procedures contained in paragraphs 4-19 through 4-38.

4-42. Adjustment and Test Point Access

4-43. Once a module has been removed from the synthesizer, the metal enclosure covers will have to be removed (in most cases) to gain access to adjustment and test points. Illustrations accompany each module alignment or test procedure and show the adjustment and test point locations.

NOTE!

When the enclosure cover on the land pattern side of the printed circuit board is removed, the rf grounding is disconnected which can cause erroneous test results. Always install at least four of the enclosure cover screws with metal spacers to provide adequate rf grounding.

4-44. Alignment or Test Signals

4-45. Module alignment or testing requires input power of +5 and ±12 vdc, in addition to specific rf signals. These inputs can be obtained from the test equipment listed in Table 4-1 or directly from the synthesizer. Adapters and extension cables that provide the necessary circuit connections are contained in the Accessory Kit furnished with the synthesizer. Accessory kit components are shown in Figure 4-3.

4-46. 5 MHz FILTER AMPLIFIER (645-4101)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 5 MHz signal having a level of 500 millivolts rms into 50-ohms to J1.

d. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

e. Adjust L2 for maximum 5 MHz signal at TP1.

f. Connect the oscilloscope probe to TP3 and adjust T1 and T3 for maximum 5 MHz signal.

g. Connect the oscilloscope input and a 50-ohm load to J3.

h. Adjust L4 for maximum 10 MHz signal at J3.

i. Adjust T1 and T3 for maximum 10 MHz signal at J3.

j. Set the oscilloscope vertical sensitivity to 0.1 v/cm and adjust its vertical centering until the upper peaks of the waveform are at the center of the CRT.

k. Adjust R25 for minimum 5 MHz signal component on the 10 MHz output signal. This is indicated when each cycle of the 10 MHz signal are equal in amplitude.

l. Position the CRT waveform with the oscilloscope controls until the complete waveform is displayed. The acceptable output signal is 1.1 ±0.1 volts peak-to-peak. If necessary, adjust R8 to obtain the specified signal level.

m. Connect the input of an rf voltmeter and a 50-ohm load to J2.

n. Adjust T2 for maximum rms voltage at J2.

o. Adjust R17 to establish a 1.0 volt rms signal at J2.

p. Disconnect the test equipment from the module and replace the enclosure covers.

4-47. Spectrum Generator (645-4102)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Adjust R8 fully clockwise.

d. Apply a 10 MHz signal having a level of 1.0 volt rms to J1.

e. Connect the input of an rf voltmeter and a 50-ohm load to J2.

f. Adjust T1 for maximum rms voltage at J2.

g. Adjust R2 to establish 1.1 volts rms at J2.

h. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

i. Adjust T2 for maximum 10 MHz signal at TP1. The acceptable signal level is between 0.4 and 0.6 volts peak-to-peak.

j. Connect the input of a spectrum analyzer and rf voltmeter to P30.

k. Adjust T3 for maximum 70 MHz signal at P30. The minimum acceptable signal level is 60 millivolts rms with P30 loaded by the spectrum analyzer and rf voltmeter.

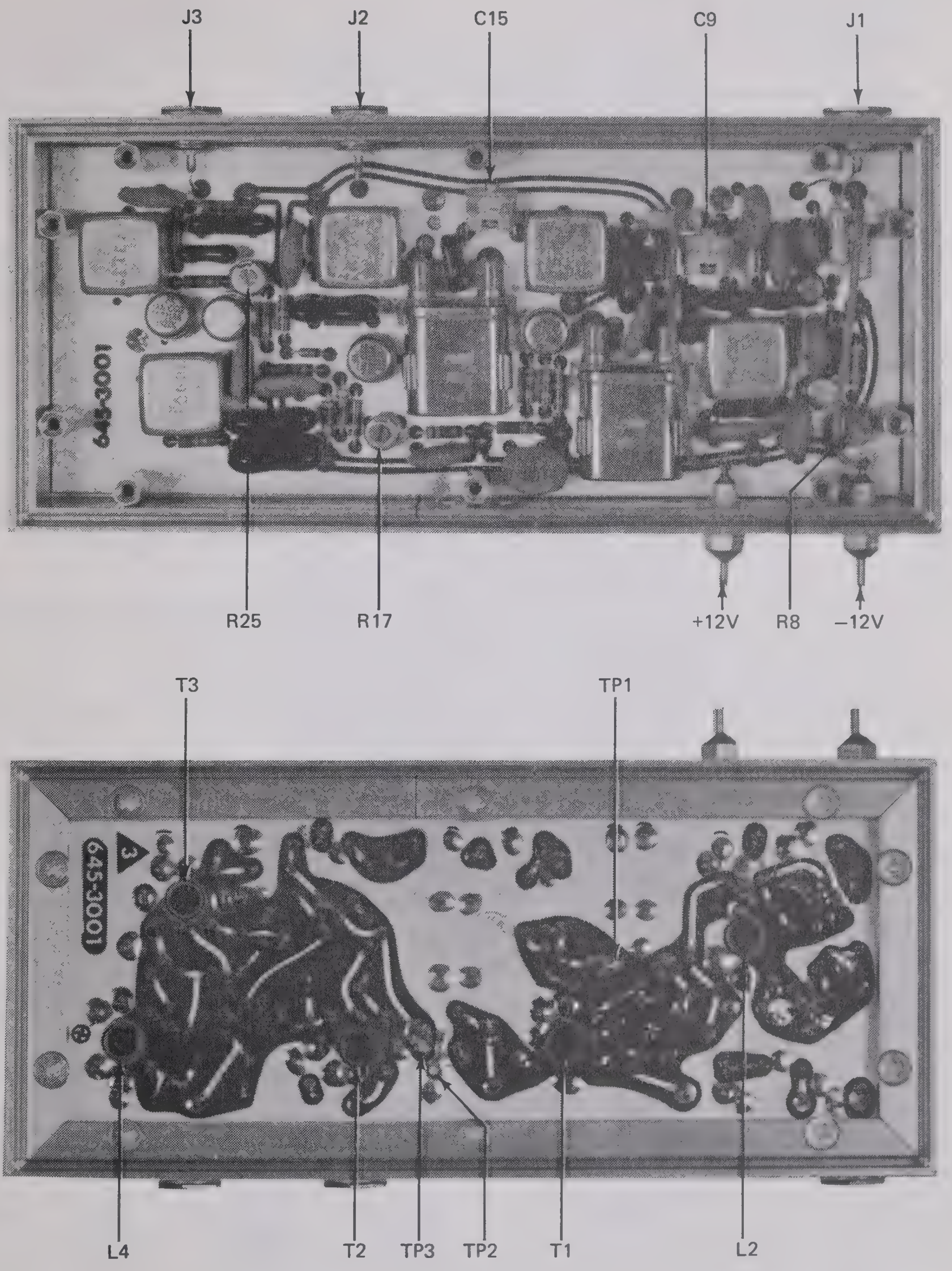

J3
J2
C15
C9
J1
R25
R17
+12V
R8
−12V
T3
TP1
645-3001
L4
T2
TP3
TP2
T1
L2

Figure 4-4. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4101)

l. Adjust R8 and R17 counter clockwise, while observing the spectrum analyzer display for a 5 MHz spectrum between the 10 MHz components. None should be observed.

m. Adjust R8 fully clockwise and R17 fully counter clockwise.

n. Install the enclosure covers on the module.

o. Using the spectrum analyzer and rf voltmeter perform the output level adjustments contained in Table 4-11.

Table 4-11. OUTPUT LEVEL ADJUSTMENTS (645-4102)

MODULE CONNECTOR	ADJUSTMENT FOR MAXIMUM OUTPUT	SIGNAL LEVEL
P30	T3	70 MHz > 60 mv rms
P29	T4	60 MHz > 60 mv rms
P31	T5	50 MHz > 50 mv rms
P32	T6	40 MHz > 60 mv rms
P33	T7	30 MHz > 60 mv rms

p. Using the spectrum analyzer, perform the checks contained in Table 4-12. The observed signal components must be below the fundamental by at least the specified level.

q. Disconnect the test equipment from the module.

4-48. 30 and 40 MHz Harmonic Selectors (645-4103 and -4104)

4-49. Alignment of the 645-4103 or 645-4104 modules is accomplished using the following procedure and the appropriate input frequency contained in Table 4-13.

Table 4-13. INPUT FREQUENCIES (645-4103 and -4104)

MODULE	INPUT FREQUENCY J1
645-4103	30 MHz
645-4104	40 MHz

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply an input signal having a level of 70 millivolts rms into 50-ohms to J1. Refer to Table 4-13 for the correct signal frequency.

d. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

e. Adjust L3 and L8 for maximum signal at TP1.

f. Disconnect the oscilloscope from the module.

g. Connect the input of an rf voltmeter and a 50-ohm load to J2.

h. Adjust L9 for maximum rms voltage at J2. Minimum acceptable signal level is 60 millivolts rms.

i. Connect the load illustrated in Figure 4-7 to J3.

Table 4-12. OUTPUT COMPONENT CHECKS (645-4102)

MODULE CONNECTOR	FUNDAMENTAL	SIGNAL COMPONENT	SIGNAL COMPONENT LEVEL BELOW FUNDAMENTAL
P30	70 MHz	60 MHz 80 MHz	5 db 15 db
P29	60 MHz	50 MHz 70 MHz	5 db 15 db
P31	50 MHz	40 MHz 60 MHz	5 db 15 db
P32	40 MHz	30 MHz 50 MHz	5 db 15 db
P33	30 MHz	20 MHz 40 MHz	5 db 15 db

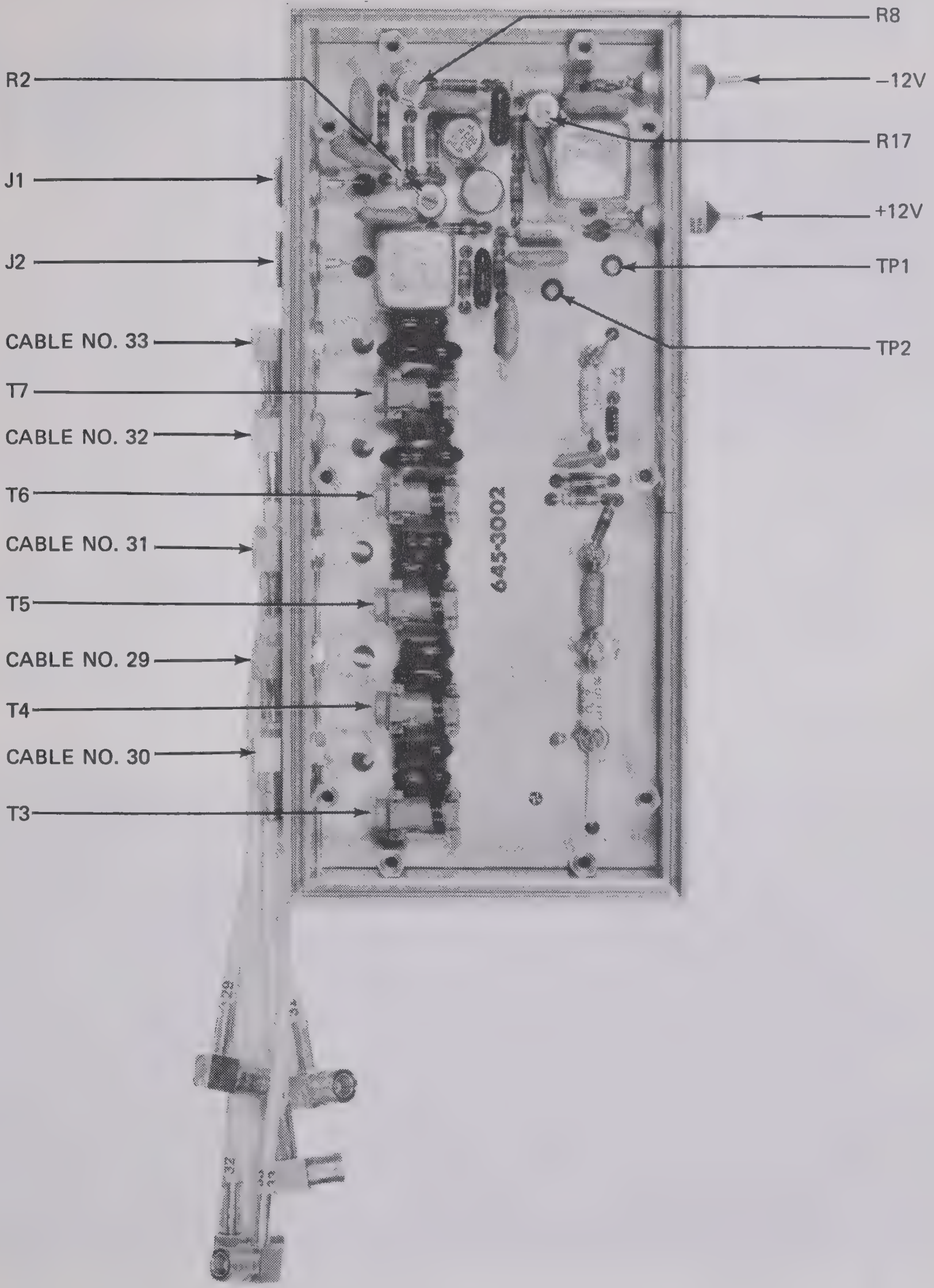

R8
R2
−12V
R17
J1
+12V
J2
TP1
TP2
CABLE NO. 33
T7
CABLE NO. 32
T6
CABLE NO. 31
T5
CABLE NO. 29
T4
CABLE NO. 30
T3
645-3002

Figure 4-5. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4102) (Sheet 1 of 2)

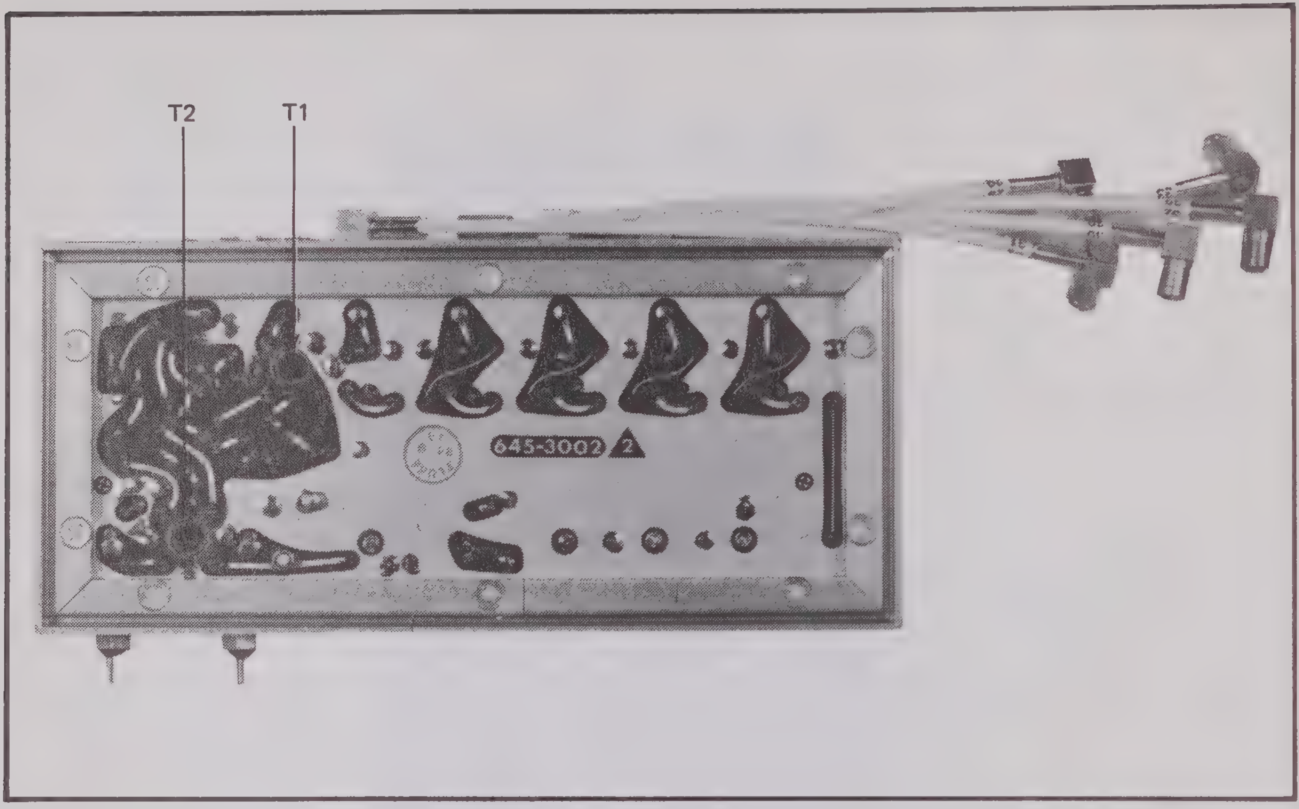

T2
T1
645-3002
2

Figure 4-5. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4102) (Sheet 2 of 2)

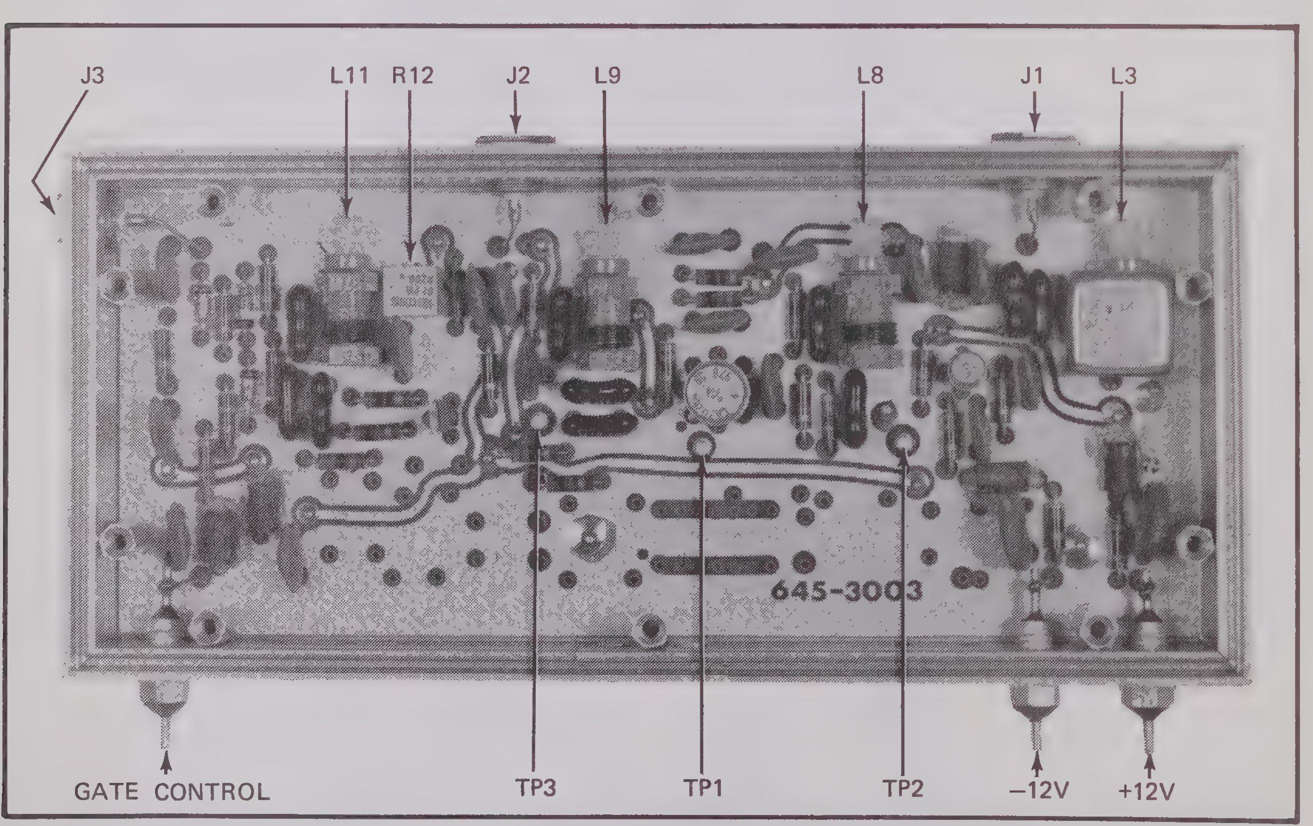

J3
L11
R12
J2
L9
L8
J1
L3
645-3003
GATE CONTROL
TP3
TP1
TP2
−12V
+12V

Figure 4-6. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4103 and -4104)

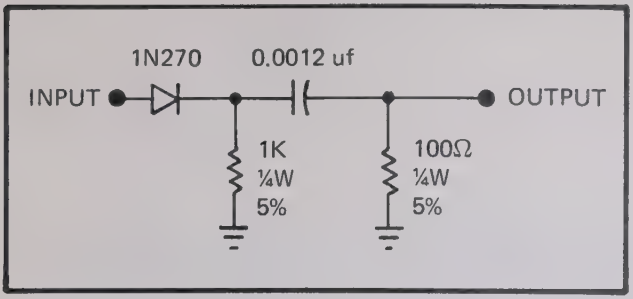


Figure 4-7. TEST LOAD

j. Connect the rf voltmeter input to the output of the load attached to J3.

k. Apply +12 volts dc to the gate control feed-thru terminal and adjust L11 for maximum rms voltage at J3.

l. Adjust R12 to each end-limit, observing the signal at J3 is controllable from 75 to 130 millivolts rms (90 to 130 mv at 40 MHz).

m. Set R12 to the center of its adjustment range and then install the enclosure covers.

n. Decrease the signal level at J1 to a level of 22 millivolts rms into 50-ohms.

o. Connect the rf voltmeter input and a 50-ohm load to J2.

p. Adjust L3 and L8 for maximum rms voltage at J2.

q. Repeat step c.

r. Adjust L9 for maximum rms voltage at J2. Minimum acceptable signal level is 60 millivolts rms.

s. Repeat steps j through l with adjustment limits from 78 to 125 millivolts rms.

t. Remove the +12 volts dc applied to the gate control feed-thru terminal, observing that the signal at J3 decreases to the noise floor of the rf voltmeter.

u. Apply +12 volts dc to the gate control feed-thru terminal and then decrease the input signal level at J1 by 5 db. The signal at J3 should not change more than 1 db with a 5 db decrease at J1.

v. Repeat step c and disconnect the rf voltmeter attached to the load at J3.

w. Connect the input of a spectrum analyzer to the output of the load attached to J3.

x. Set the spectrum analyzer display width to 100 MHz/cm. Spurious oscillations should not be detected up to 1 GHz.

y. Remove the input signal applied to J1. Fundamental oscillations should not be detected at J3.

z. Disconnect the test equipment from the module.

4-50. 50 and 60 MHz Harmonic Selectors (645-4105 and -4106)

4-51. Alignment of the 645-4105 or 645-4106 modules is accomplished using the following procedure and the appropriate input frequency contained in Table 4-14.

Table 4-14. INPUT FREQUENCIES (645-4105 and -4106)

MODULE	INPUT FREQUENCY J1
645-4105	50 MHz
645-4106	60 MHz

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply an input signal having a level of 70 millivolts rms into 50-ohms to J1. Refer to Table 4-14 for the correct signal frequency.

d. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

e. Adjust L3 and L8 for maximum signal at TP1.

f. Connect the oscilloscope input to TP3 and adjust L9 for maximum signal.

g. Disconnect the oscilloscope from the module.

h. Connect the load illustrated in Figure 4-7 to J2.

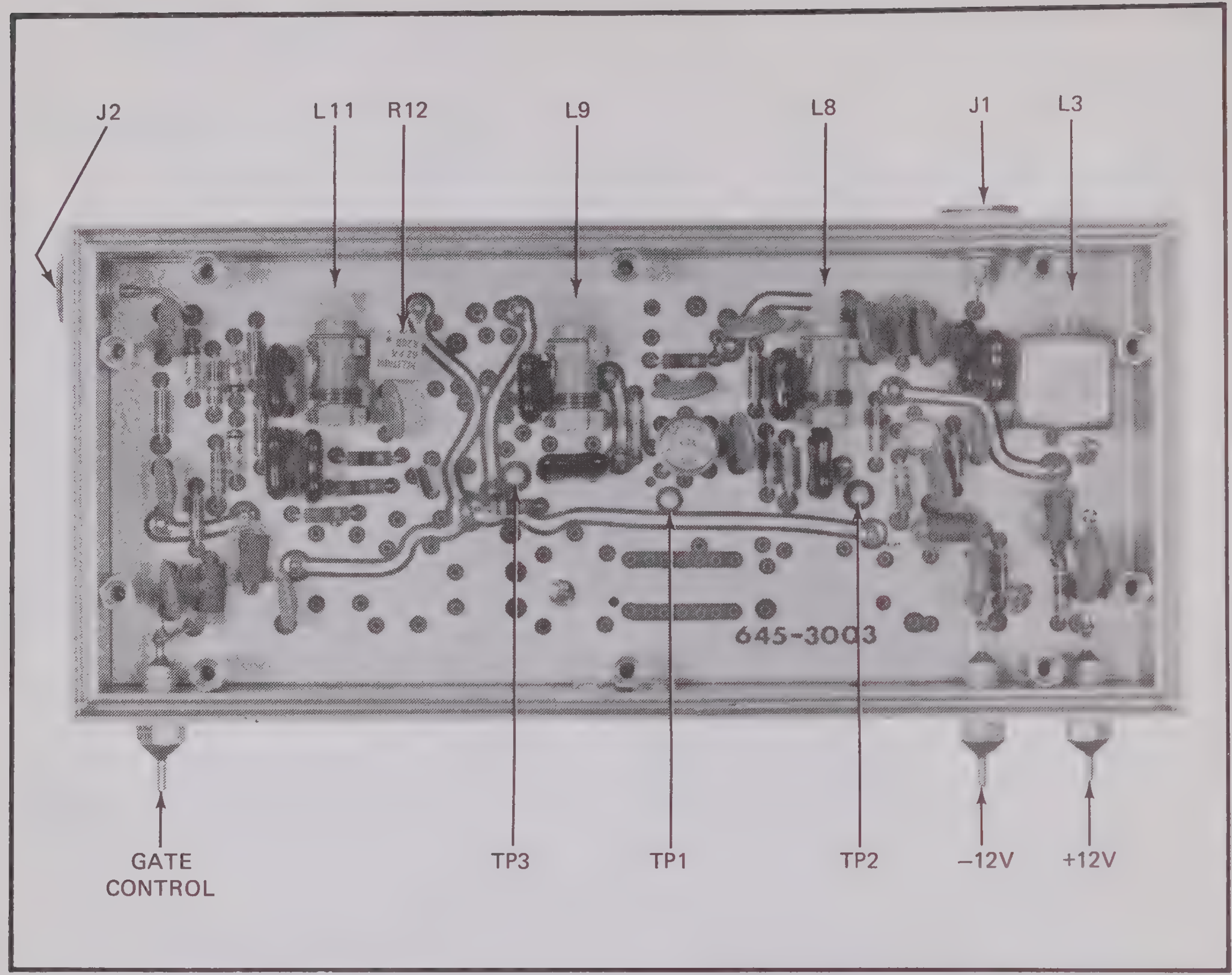


Figure 4-8. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4105 and -4106)

i. Connect the rf voltmeter input to the output of the load attached to J2.

j. Apply +12 volts dc to the gate control feed-thru terminal and adjust L11 for maximum rms voltage at J2.

k. Adjust R12 to each end-limit, observing that the signal at J2 is controllable from 75 to 130 millivolts rms.

l. Set R12 to the center of its adjustment range and then install the enclosure covers.

m. Decrease the signal level at J1 to a level of 22 millivolts rms into 50-ohms.

n. Adjust L3 and L8 for maximum rms voltage at J2.

o. Repeat step c.

p. Adjust L9 and L11 for maximum rms voltage at J2.

q. Adjust R12 to each end-limit, observing that the signal at J2 is controllable from 78 to 125 millivolts rms.

r. Adjust R12 to the center of its adjustment range.

s. Remove the +12 volts dc applied to the gate control feed-thru terminal, observing that the signal at J3 decreases to the noise floor of the rf voltmeter.

t. Apply +12 volts dc to the gate control feed-thru terminal and then decrease the input signal at J1 by 5 db. The signal at J2 should not change more than 1 db with a 5 db decrease at J1.

u. Repeat step c and disconnect the rf voltmeter attached to the load at J2.

v. Connect the input of a spectrum analyzer to the output of the load attached to J2.

w. Set the spectrum analyzer display width to 100 MHz/cm. Spurious oscillations should not be detected up to 1 GHz.

x. Remove the input signal applied to J1. Fundamental oscillations should not be detected at J2.

y. Disconnect the test equipment from the module.

4-52. 70 MHz Harmonic Selector (645-4107)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply +5 and ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 70 MHz signal having a level of 70 millivolts rms into 50-ohms to J1.

d. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

e. Adjust L3 and L8 for maximum signal at TP1.

f. Connect the oscilloscope input to TP3 and adjust L9 for maximum signal.

g. Disconnect the oscilloscope from the module.

h. Connect the input of an rf voltmeter and a 50-ohm load to J2.

i. Adjust L10 for maximum rms voltage at J2. Minimum acceptable signal level is 135 millivolts rms.

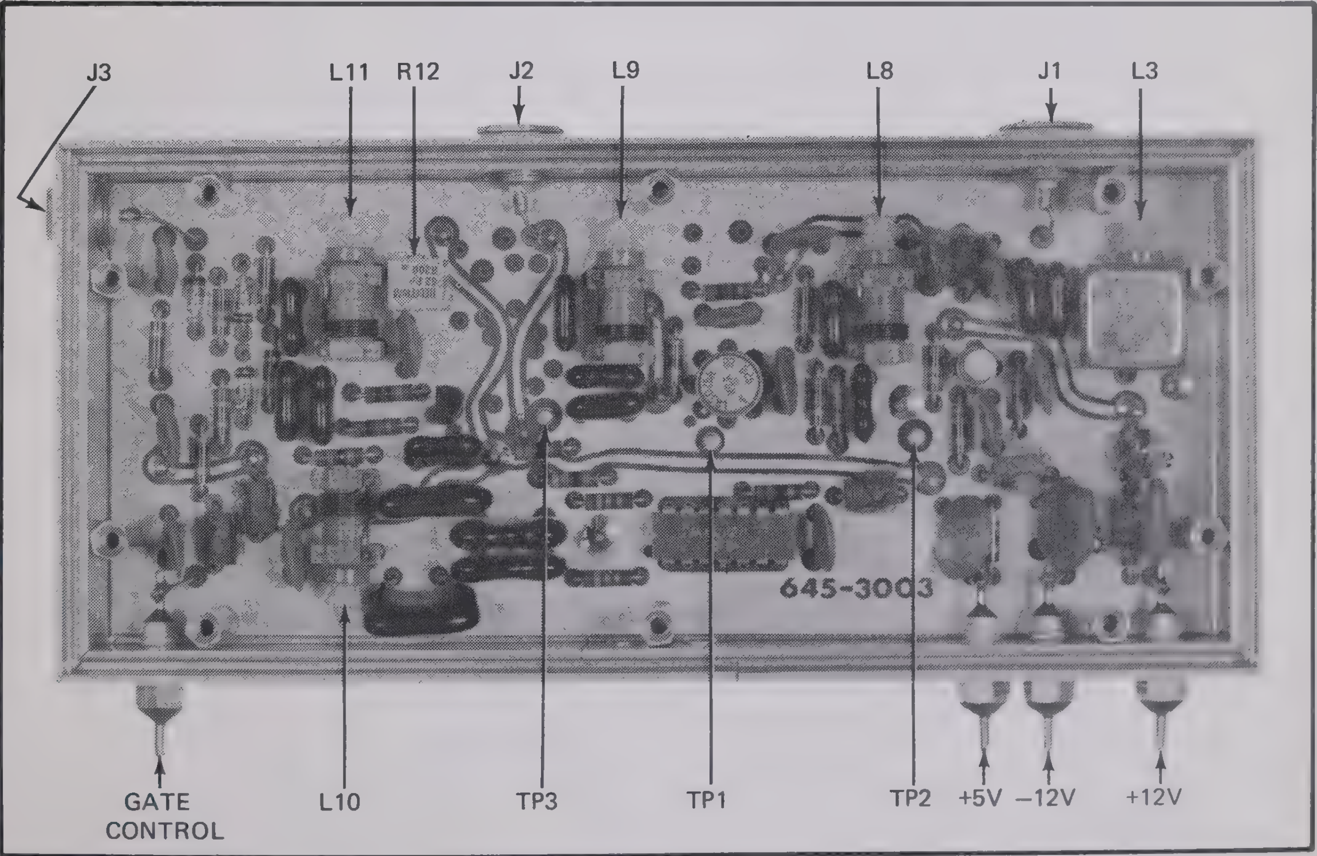


Figure 4-9. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4107)

j. Connect the load illustrated in Figure 4-7 to J3.

k. Connect the rf voltmeter input to the output of the load attached to J3.

l. Apply +12 volts dc to the gate control feed-thru terminal and adjust L11 for maximum rms voltage at J3.

m. Adjust R12 to each end-limit, observing the signal at J3 is controllable from 75 to 130 millivolts rms.

n. Set R12 to the center of its adjustment range and then install the enclosure covers.

o. Apply a 70 MHz signal having a level of 22 millivolts rms into 50-ohms to J1.

p. Adjust L3 and L8 for maximum rms voltage at J3.

q. Repeat step c and then adjust L9 and L11 for maximum signal at J3.

r. Adjust R12 to each end-limit, observing the signal at J3 is controllable from 78 to 125 millivolts rms.

s. Set R12 to the center of its adjustment range.

t. Remove the +12 volts dc from the gate control feed-thru terminal, observing that the signal at J3 decreases to the noise floor of the rf voltmeter.

u. Apply +12 volts dc to the gate control feed-thru terminal and then decrease the input signal level at J1 by 5 db. The signal at J3 should not change more than 1 db with a 5 db decrease at J1.

v. Repeat step c.

w. Connect the rf voltmeter input to J2. Terminate J2 with a 50-ohm load.

x. Adjust L10 for maximum rms voltage at J2. Minimum acceptable signal level is 130 millivolts rms. Record the exact value.

y. Repeat step o, observing that the signal level at J2 does not change more than 0.2 db from the level recorded in step x.

z. Repeat step c.

aa. Connect the input of a spectrum analyzer to the output of the load attached to J3.

ab. Set the spectrum analyzer display width to 100 MHz/cm. Spurious oscillations should not be detected up to 1 GHz.

ac. Remove the input signal applied to J1. Fundamental oscillations at 70 MHz should not be detected at J3.

ad. Disconnect the test equipment from the module.

4-53. 30 and 40 MHz 10:1 Dividers (645-4108 and -4109)

4-54. Alignment of the 645-4108 or 645-4109 modules is accomplished using the following procedure and the appropriate input frequency contained in Table 4-15.

Table 4-15. INPUT FREQUENCIES (645-4108 and -4109

MODULE	INPUT FREQUENCY J1
645-4108	30 MHz
645-4109	40 MHz

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply +5 and ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply an input signal having a level of 70 millivolts rms into 50-ohms to J1. Refer to Table 4-15 for the correct input signal frequency.

d. Connect the input of an oscilloscope to TP2 and its ground lead to TP1. Use a 10:1 probe with the oscilloscope.

e. Adjust L2 for maximum signal at TP2.

f. Connect the input of an rf voltmeter and a 50-ohm load to J2.

g. Adjust L4 for maximum rms voltage at J2

h. Disconnect the rf voltmeter and 50-ohm load from J2.

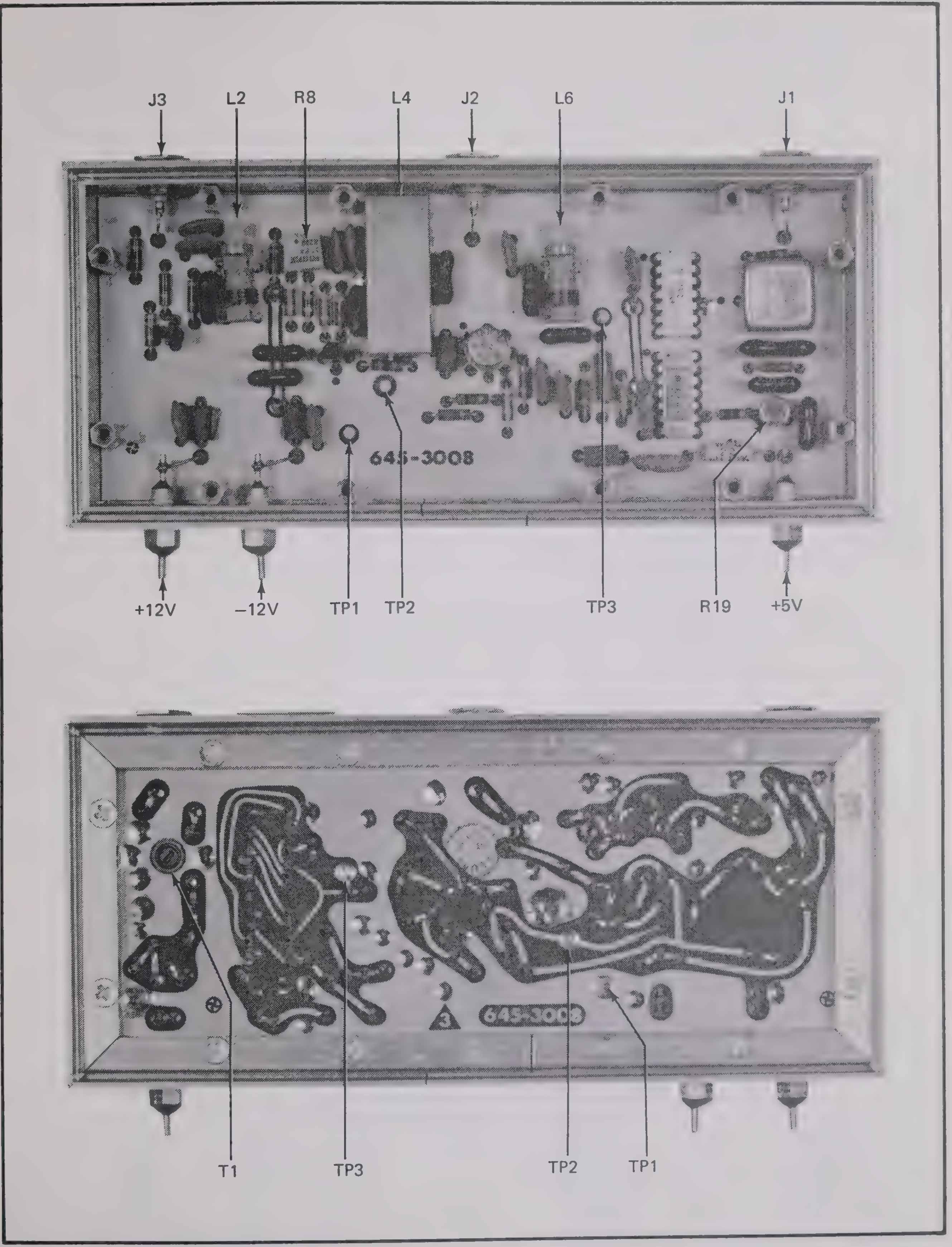

J3
L2
R8
L4
J2
L6
J1
645-3008
+12V
−12V
TP1
TP2
TP3
R19
+5V
645-3008
T1
TP3
TP2
TP1

Figure 4-10. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4108 and -4109)

i. Connect the oscilloscope input to TP3 and adjust L6 for maximum signal.

j. Disconnect the oscilloscope from the module.

k. Connect the rf voltmeter input and 50-ohm load to J3.

l. Adjust T1 for maximum rms voltage at J3.

m. Adjust R19 for a 225 millivolt rms signal at J3.

n. Install the enclosure covers and connect the rf voltmeter input and 50-ohm load to J2.

o. Adjust L2 and L4 for maximum rms voltage at J2.

p. Adjust R8 for a 225 millivolt rms signal at J2.

q. Connect the rf voltmeter input and 50-ohm load to J3.

r. Connect a continuously adjustable attenuator in series with the input signal applied to J1.

s. Decrease the signal level at J1 with the attenuator until the signal level at J3 starts to decrease.

t. Adjust L6 for maximum signal level at J3.

u. Repeat steps s and t until the signal level at J3 can no longer be sustained.

v. Repeat step c, observing that a 225 millivolt rms output signal is present at J3.

w. Apply an input signal having a level of 22 millivolts rms into 50-ohms to J1. The signal level at J3 should not change more than 0.2 db from the value established in step v.

x. Disconnect the test equipment from the module.

4-55. 31-39 MHz Mixers (645-4121 thru -4128)

4-56. Alignment of the 645-4121 through 645-4128 modules is accomplished using the following procedure and the appropriate input frequencies contained in Table 4-16. Output frequencies are also contained in this Table.

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply input signals having a level of 20 and 100 millivolts rms into 50-ohms to J1 and J3, respectively. Refer to Table 4-16 for the input signal frequency.

d. Connect the input of a spectrum analyzer to J2. Set the spectrum analyzer display width to 3 MHz/cm, and tune the analyzer to the output frequency contained in Table 4-16.

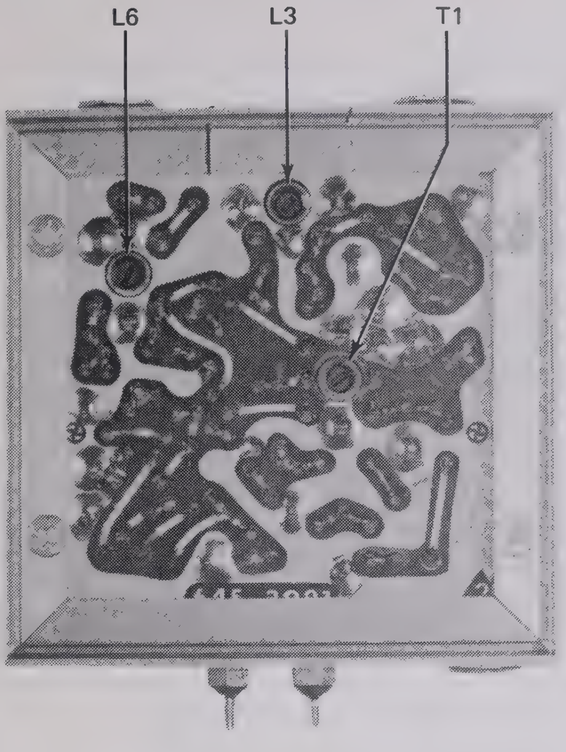
e. Adjust L3 for maximum output at the frequency specified in Table 4-16.

f. Increase the signal level at J1 to 100 millivolts rms into 50-ohms.

g. Adjust T1 and L6 for maximum output at the frequency specified in Table 4-16.

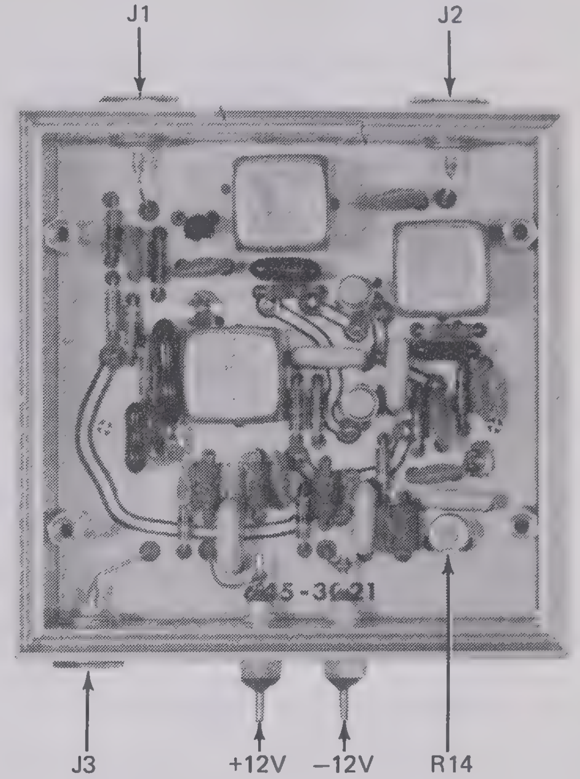
Table 4-16. INPUT AND OUTPUT FREQUENCIES. (645-4121 thru 4128).

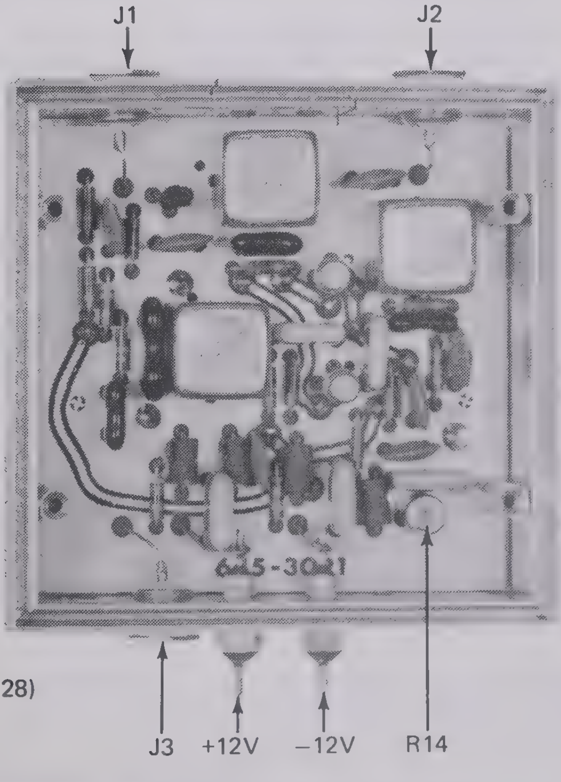
MODULE	INPUT FREQUENCIES		OUTPUT FREQUENCIES
	J1	J3	J2
645-4121	35 MHz	4 MHz	31 MHz
645-4122	35 MHz	3 MHz	32 MHz
645-4123	30 MHz	3 MHz	33 MHz
645-4124	30 MHz	4 MHz	34 MHz
645-4125	40 MHz	4 MHz	36 MHz
645-4126	40 MHz	3 MHz	37 MHz
645-4127	35 MHz	3 MHz	38 MHz
645-4128	35 MHz	4 MHz	39 MHz


L6
L3
T1
645-3001

(645-4121 thru -4128)

(645-4122, -4123, -4126, -4127)


J1
J2
645-3021
J3
+12V
−12V
R14


J1
J2
645-3021
J3
+12V
−12V
R14

(645-4121, -4124, -4125, -4128)

Figure 4-11. ADJUSTMENT AND INPUT/OUTPUT CONNECTIONS (645-4121 thru -4128)

h. Adjust R14 for minimum amplitude carrier component (J1 input frequency) at J2. This signal component must be at least 20 db below the desired output frequency at J2. The undesired sum or difference frequency of the input signals at J1 and J3 must also be at least 15 db below the desired output frequency.

i. Disconnect the spectrum analyzer from the module.

j. Connect the input of an rf voltmeter and a 100-ohm load to J2. Minimum acceptable signal level is 70 millivolts rms.

k. Disconnect the test equipment from the module and replace the enclosures covers.

4-57. 30-39 MHz Filters (645-4129-1 thru -5)

4-58. Alignment of the 645-4129-1 through -5 modules is accomplished using the following procedure and the appropriate input frequencies contained in Table 4-17.

Table 4-17. INPUT FREQUENCIES
(645-4129-1 thru -5)

MODULE	INPUT FREQUENCIES	
	J3	J6
645-4129-1	30 MHz	35 MHz
645-4129-2	31 MHz	36 MHz
645-4129-3	32 MHz	37 MHz
645-4129-4	33 MHz (J4)	38 MHz (J7)
645-4129-5	34 MHz	39 MHz

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply +12 volts dc to the feed-thru terminal adjacent to the metal decal. Connect the power supply common to the module chassis.

c. Apply an input signal having a level of 40 millivolts rms into 50-ohms to J3. Refer to Table 4-17 for the input signal frequency.

d. Connect the input of an rf voltmeter and a 50-ohm load to J2.

NOTE!

The adjustments of step e through m are located on the side of the module containing the metal decal.

e. Adjust L1, L2, L3, and L4 for maximum rms voltage at J2. Repeat this step several times.

f. Increase the signal level at J3 to 125 millivolts rms into 50-ohms.

g. Adjust L5 for maximum rms voltage at J2.

h. Adjust L6 for minimum rms voltage at J2.

i. Adjust L7 for maximum rms voltage at J2. Minimum acceptable signal level is 270 millivolts rms.

j. Connect the isolator illustrated in Figure 4-13 to J1.

k. Connect the rf voltmeter input to the output of the isolator attached to J1.

l. Apply +12 volts dc to the gate control feed-thru terminal located adjacent to J1.

m. Readjust L5, L6, and L7 for maximum rms voltage at J1. Acceptable signal level is 160 to 280 millivolts rms.

n. Remove the +12 volts dc applied to the gate control feed-thru terminal, observing that the signal at J1 decreases to the noise floor of the rf voltmeter.

o. Transfer the +12 volt dc power lead to the feed-thru terminal adjacent to J5.

p. Apply an input signal having a level of 40 millivolts rms into 50-ohms to J6. Refer to Table 4-17 for the input signal frequency.

q. Connect the rf voltmeter input and a 50-ohm load to J5.

NOTE!

The adjustments for each of the following steps are located on the side of the module containing J4 through J6.

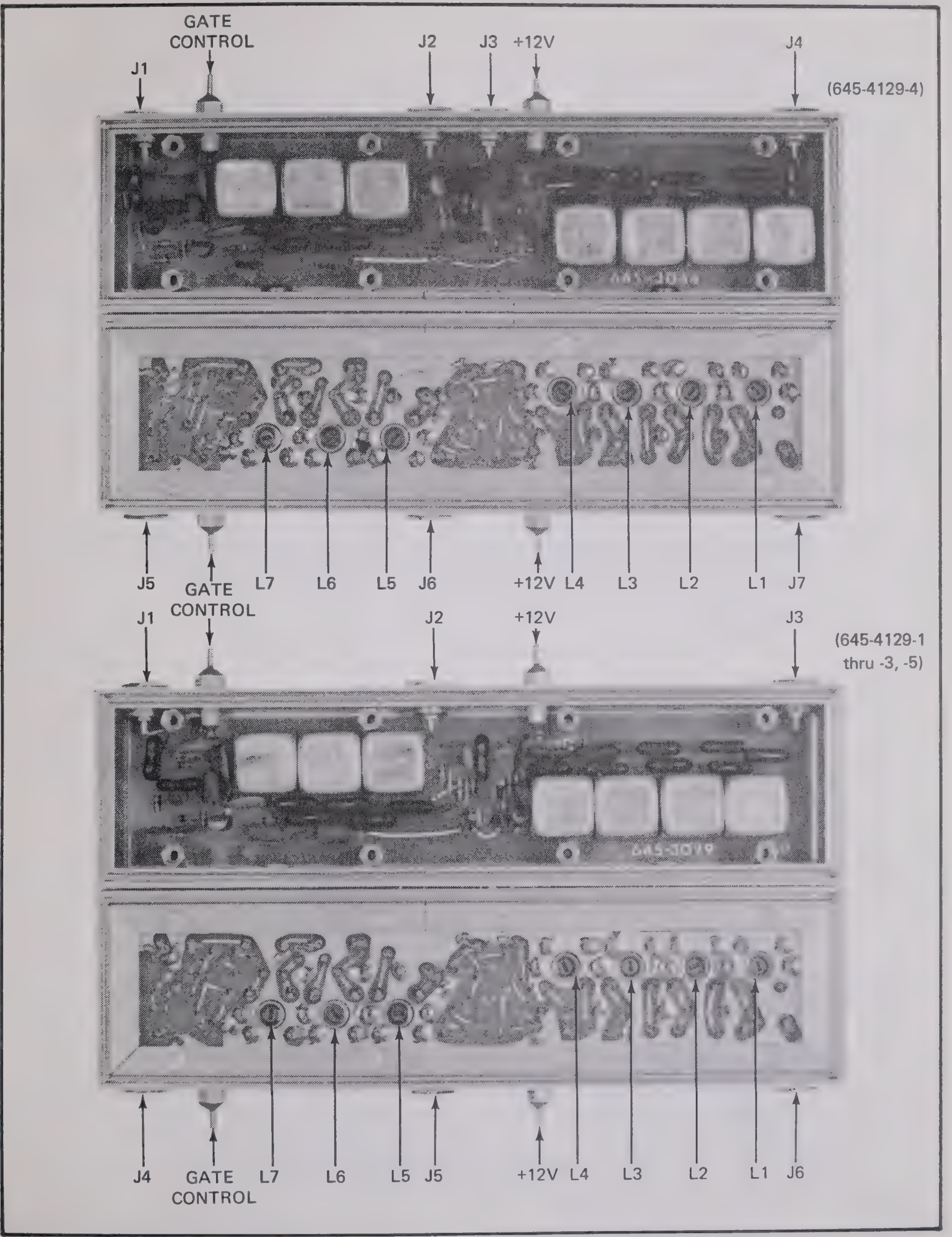

GATE CONTROL
J1
J2
J3
+12V
J4
(645-4129-4)
J5
GATE CONTROL
L7
L6
L5
J6
+12V
L4
L3
L2
L1
J7
J1
GATE CONTROL
J2
+12V
J3
(645-4129-1 thru -3, -5)
J4
GATE CONTROL
L7
L6
L5
J5
+12V
L4
L3
L2
L1
J6

Figure 4-12. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4129-1 thru -5)

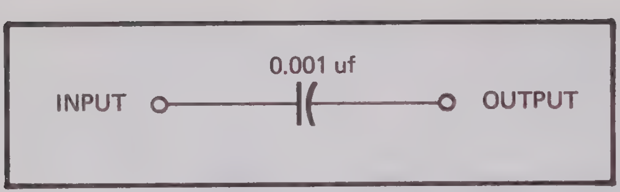


Figure 4-13. ISOLATOR

r. Adjust L1, L2, L3, and L4 for maximum rms voltage at J5. Repeat this step several times.

s. Increase the signal level at J6 to 125 millivolts rms into 50-ohms.

t. Adjust L5 for maximum rms voltage at J5.

u. Adjust L6 for minimum rms voltage at J5.

v. Adjust L7 for maximum rms voltage at J5. Minimum acceptable signal level is 270 millivolts rms.

w. Connect the isolator illustrated in Figure 4-13 to J4.

x. Connect the rf voltmeter input to the output of the isolator attached to J4.

y. Apply +12 volts dc to the gate control feed-thru terminal located adjacent to J4.

z. Readjust L5, L6, and L7 for maximum rms voltage at J4. Acceptable signal level is 160 to 250 millivolts rms.

aa. Remove the +12 volts dc applied to the gate control feed-thru terminal, observing that the signal at J4 decreases below the noise floor of the rf voltmeter.

ab. Disconnect the test equipment from the module and replace the enclosure covers.

4-59. 30 - 39 MHz Gate (645-4133)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Connect the adaptor illustrated in Figure 4-15 to J1.

c. Apply +12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

d. Apply a 20 to 50 MHz sweep generator signal having a level of –5 dbm into 50-ohms to a step attenuator. Set the step attenuator to 0 db and connect its output to the adaptor attached to J1.

e. Interconnect the sweep generator and a sweep analyzer to provide a 25 to 45 MHz display having 10 MHz frequency markers.

f. Connect the input of the sweep analyzer to J6.

g. Apply +12 volts dc to the adaptor connected to J1.

h. Adjust R70 fully clockwise.

i. Adjust L13 and T1 for an overcoupled response between 30 and 40 MHz at J6. Maximum signal variation at J6 is 0.7 db.

j. Set the step attenuator to 4 db, observing that the output signal at J6 does not change more than 0.3 db.

k. Set the step attenuator to 0 db.

l. Disconnect the adaptor from J1 and connect it to J2.

m. An overcoupled response between 30 and 40 MHz should be present at J6. Maximum signal variation is 0.7 db.

n. Repeat steps j and k.

o. Repeat steps m and n with adaptor sweep signal applied to input connectors J3 through J5 and J7 through J11.

p. Disconnect the sweep analyzer from the module.

q. Connect the input of an rf voltmeter and a 50-ohm load to J6.

r. Apply a 35 MHz signal having a level of –5 dbm into 50-ohms through a step attenuator and an adaptor to J1.

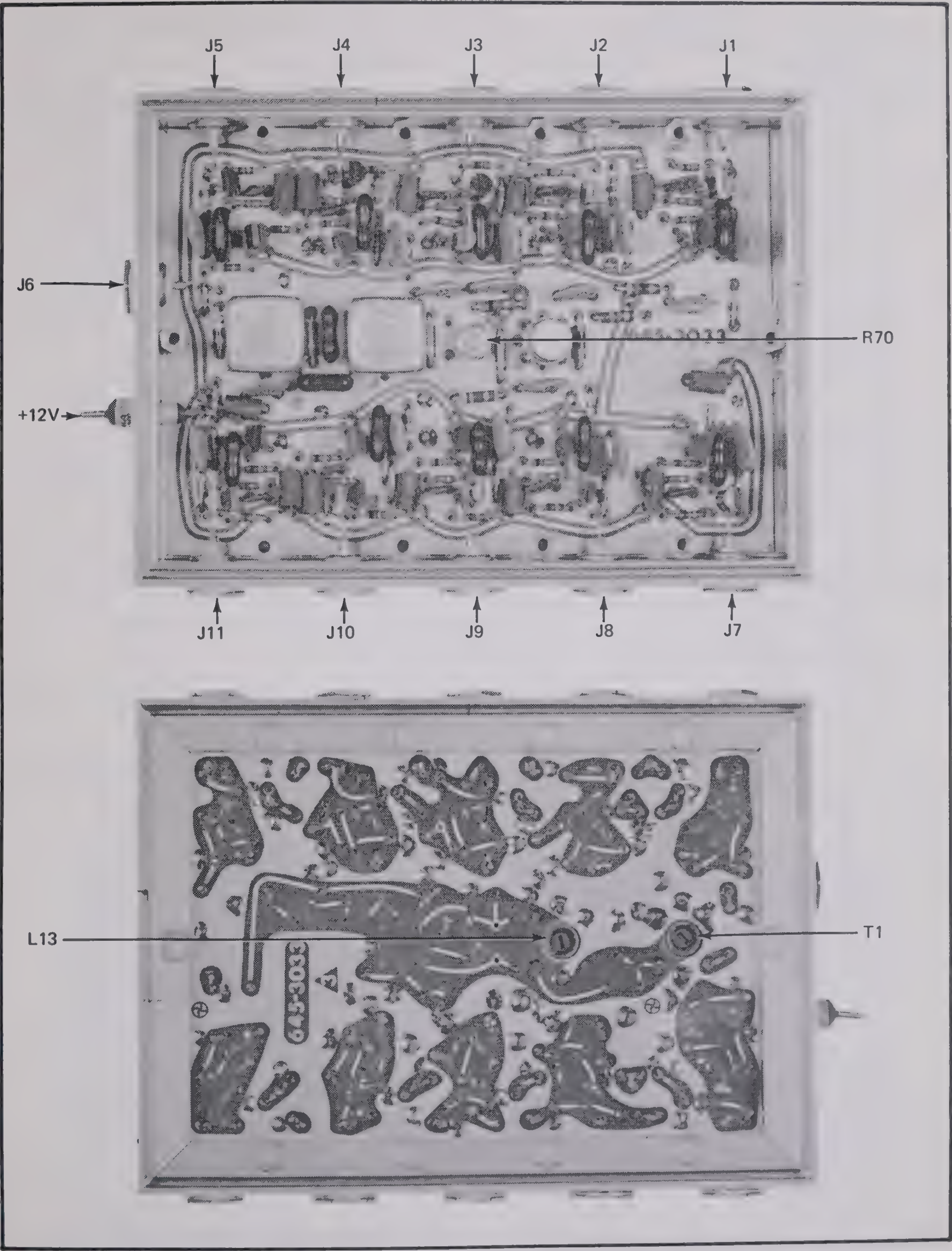

J5
J4
J3
J2
J1
J6
R70
+12V
J11
J10
J9
J8
J7
L13
T1

Figure 4-14. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4133)

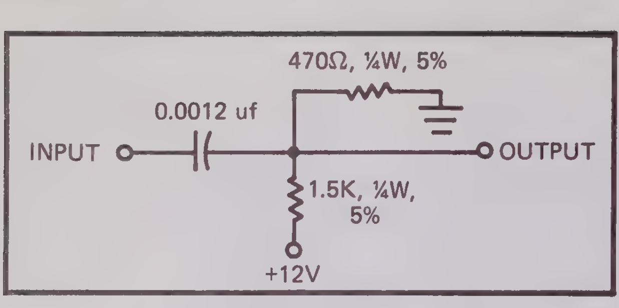


Figure 4-15. ADAPTOR

s. Adjust R70 for a –8 dbm (35 MHz) output signal level at J6.

t. Disconnect the test equipment from the module and replace the enclosure covers.

4-60. Gate Matrix (645-4134)

4-61. This module assembly contains 96 rf gates mounted on 12 individual printed circuit boards (8 rf gates per board). Refer to the Schematic Diagram, Drawing No. 645-1034, for the specific function of each individual gate. Due to the complex construction of this module, the assembly must be returned to the factory for servicing.

4-62. Search VCO (644-4124)

a. Remove the enclosure cover from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

b. Apply ±12 volts dc and ground to the appropriate feed-thru terminals on the module.

c. Connect a 50-ohm load and the frequency counter input to J2. A signal having a frequency of approximately 3 MHz should be present at J2.

d. Apply –2.5 volts dc to TP1 and adjust R40 for an output frequency of 2.9 MHz, ±200 Hz, at J2.

e. Apply +2.5 volts dc to TP1 and adjust C8 for an output frequency of 3.1 MHz ±200 Hz, at J2.

f. Repeat steps d and e until the specified results are obtained.

g. Disconnect the dc voltage applied to TP1 and apply +10 volts dc to J1.

h. Connect a jumper from TP6 to TP2 and adjust R1 for an output frequency of 3.09955 MHz, ±100 Hz, at J2.

i. Apply +7.5 volts dc to J1 and record the output frequency deviation above or below 3.075 MHz at J2.

j. Adjust R2 for an output frequency of 3.075 MHz plus four times the deviation noted in step i. For example, if the frequency counter indicated 3.07456 MHz in step i, the recorded deviation would be –0.44 kHz. R2 would then be adjusted until an output frequency of 3.0734 MHz [3.075 + (–0.44)] is preset at J2.

k. Repeat steps h through j until the specified results are obtained.

l. Perform the adjustments contained in Table 4-18.

m. Perform the checks contained in Table 4-19, observing that the output frequency at J2 is within ±100 Hz for each check. If necessary, adjust the appropriate segment and any following segments until the specified output frequency at J2 is obtained.

n. Remove input power from the module and replace the enclosure cover.

o. Apply input power to the module and apply +10 volts dc to J1.

p. Adjust C8 for an output frequency of 3.09955 MHz ±100 Hz at J2.

q. Repeat step m.

r. Disconnect the frequency counter from the module and connect the rf voltmeter input to J2.

s. Vary the dc control voltage applied to J1 from +10

t. Disconnect the test equipment from the module.

4-63. Search Mixer (645-4146)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

Table 4-18. LINEARIZING NETWORK ADJUSTMENTS (644-4124)

JUMPER WIRE CONNECTION	INPUT VOLTAGE (DC VOLTS)	ADJUSTMENT	FREQUENCY COUNTER READING AT J2 (± 100 Hz)
TP6 to TP3	+6.7 volts	R3	3066.55 kHz
TP6 to TP3	+3.6 volts	R4	3036. kHz
TP6 to TP4	+2.9 volts	R5	3028.55 kHz
TP6 to TP4	–0.7 volts	R6	2993. kHz
TP6 to TP5	–1.4 volts	R7	2985.55 kHz
TP6 to TP5	–5.2 volts	R8	2948. kHz
NONE	–6.2 volts	R9	2937.55 kHz
NONE	–10 volts	R10	2899.55 kHz

Table 4-19. INPUT VOLTAGE VERSUS OUTPUT FREQUENCY CHECKS (644-4124).

INPUT CONTROL VOLTAGE J_	OUTPUT FREQUENCY J2	ALIGNMENT AND ADJUSTMENT	
+10	3099.55 kHz	Step h thru k	R1
+7.5	3075. kHz	Step h thru k	R2
+6.7	3066.55 kHz	Step 1	R3
+3.6	3036. kHz	Step 1	R4
+2.9	3028.55 kHz	Step 1	R5
–0.7	2993. kHz	Step 1	R6
–1.4	2985.55 kHz	Step 1	R7
–5.2	2948. kHz	Step 1	R8
–6.2	2937.55 kHz	Step 1	R9
–10	2899.55 kHz	Step 1	R10

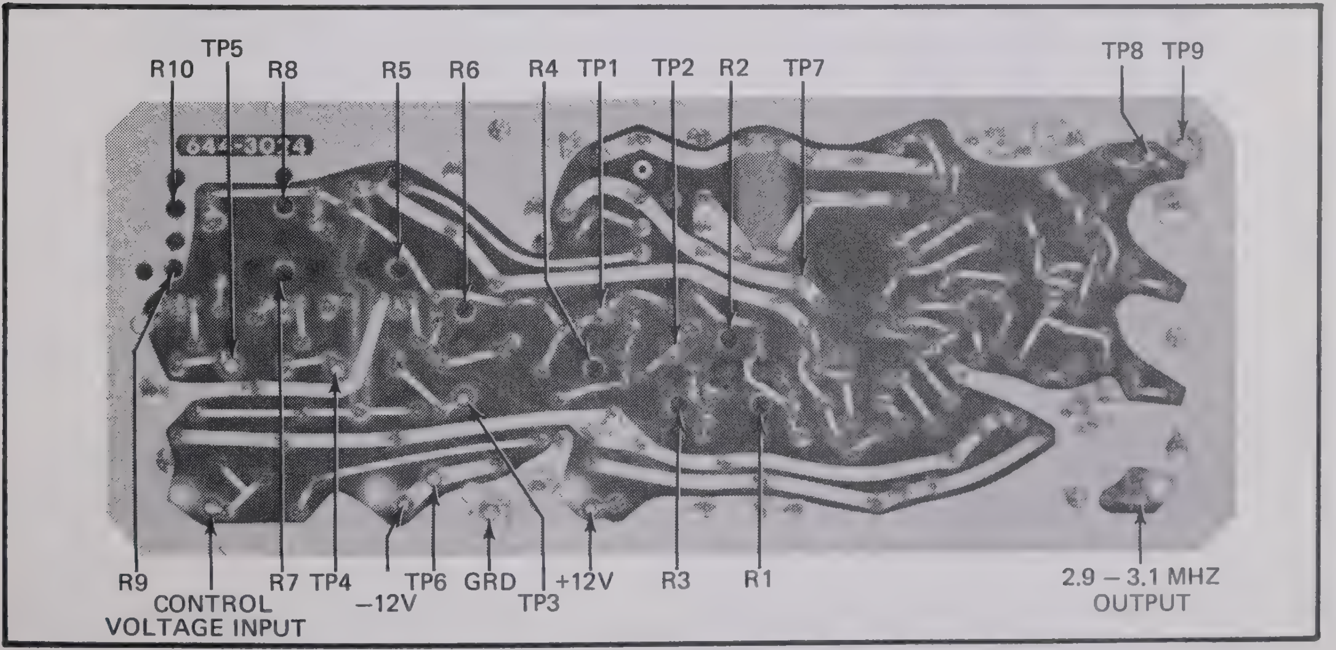

R10
TP5
R8
R5
R6
R4
TP1
TP2
R2
TP7
TP8
TP9
R9
CONTROL VOLTAGE INPUT
R7
TP4
–12V
TP6
GRD
TP3
+12V
R3
R1
2.9 – 3.1 MHZ OUTPUT

Figure 4-16. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTION LOCATIONS (644-4124)

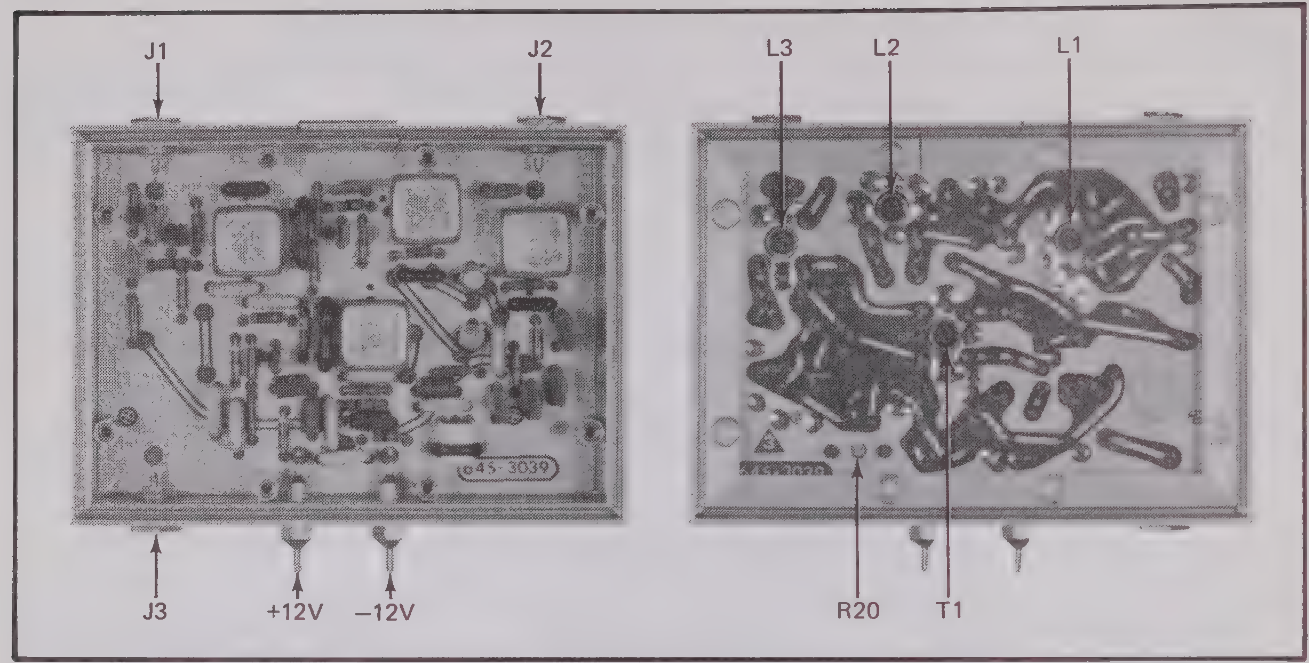


Figure 4-17. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4146)

b. Apply ±12 volts dc to the appropriate feed-thru terminals of the module. Connect the power supply common to the chassis of the module.

c. Apply a 3 MHz signal having a level of −10 dbm into 50-ohms to J3.

d. Apply a 30 MHz signal having a level of −1 dbm into 50-ohms to J1.

e. Connect the input of a spectrum analyzer to J2. Tune the spectrum analyzer to 33 MHz.

f. Adjust L1, L2, T1, and L3 for maximum 33 MHz signal at J2.

g. Adjust R20 for minimum amplitude 30 MHz signal at J2.

h. Repeat steps f and g.

i. Observe that the 27 and 30 MHz components are at least 20 db down from the 33 MHz output signal at J2.

j. Disconnect the spectrum analyzer from the module.

k. Connect the input of an rf voltmeter and a 50-ohm load to J2. Minimum acceptable signal level at J2 is −6 dbm.

l. Disconnect the test equipment from the module and replace the enclosure covers.

4-64. Digit Adder Filter/Search Oscillator Filter (645-4129-6)

4-65. DIGIT ADDER FILTER ALIGNMENT.

a. Remove the enclosure cover on the side of the module nearest J2.

b. Apply a 37 MHz signal having a level of −2 dbm into 50-ohms to J2.

c. Connect the input of an rf voltmeter and a 50-ohm load to J1.

d. Adjust L1 through L4 for maximum rms voltage at J1. Minimum acceptable signal level is −10 dbm.

e. Disconnect the test equipment from the module and replace the enclosure cover.

4-66. SEARCH OSCILLATOR FILTER ALIGNMENT.

a. Remove the cover on the side of the module nearest J1.

b. Apply +12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

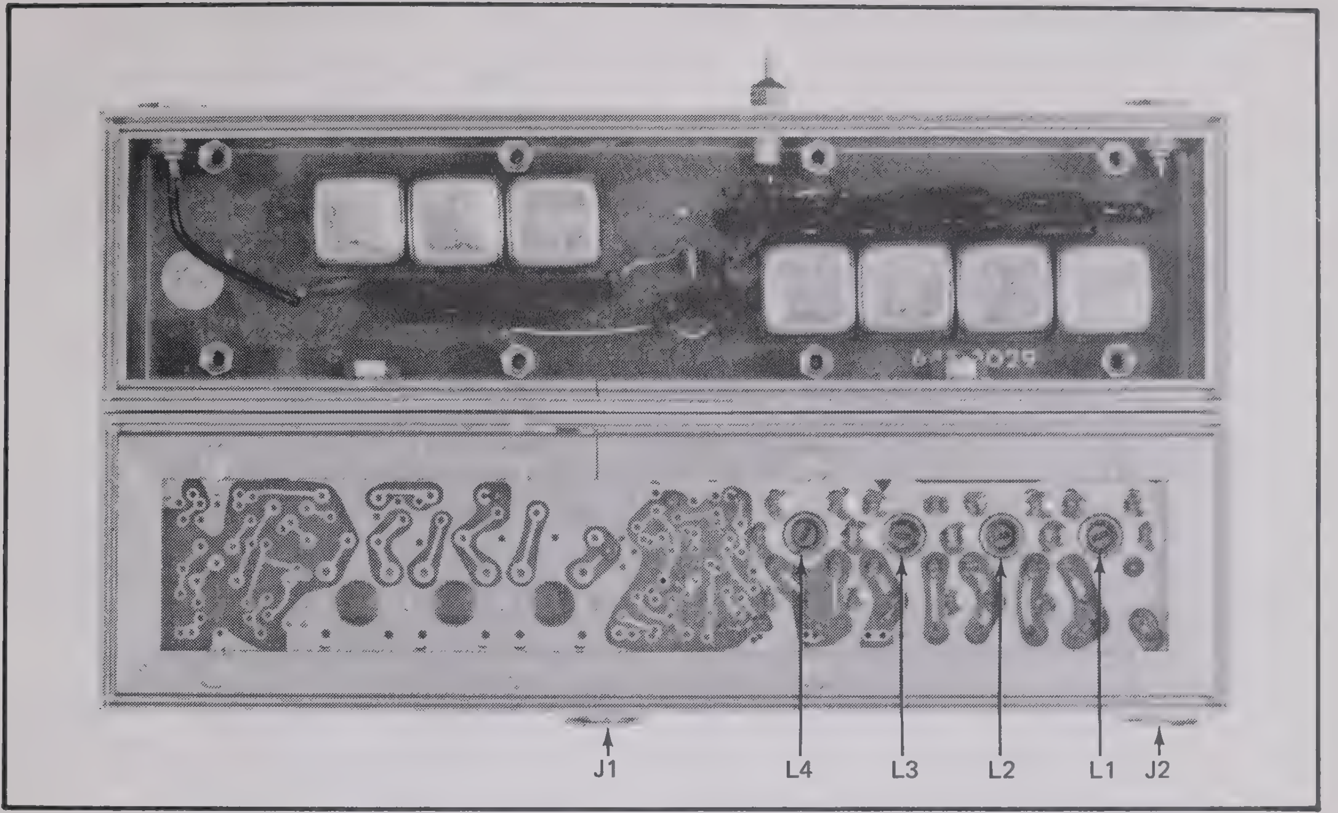

645-3029
J1
L4
L3
L2
L1
J2

Figure 4-18. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4129-6)

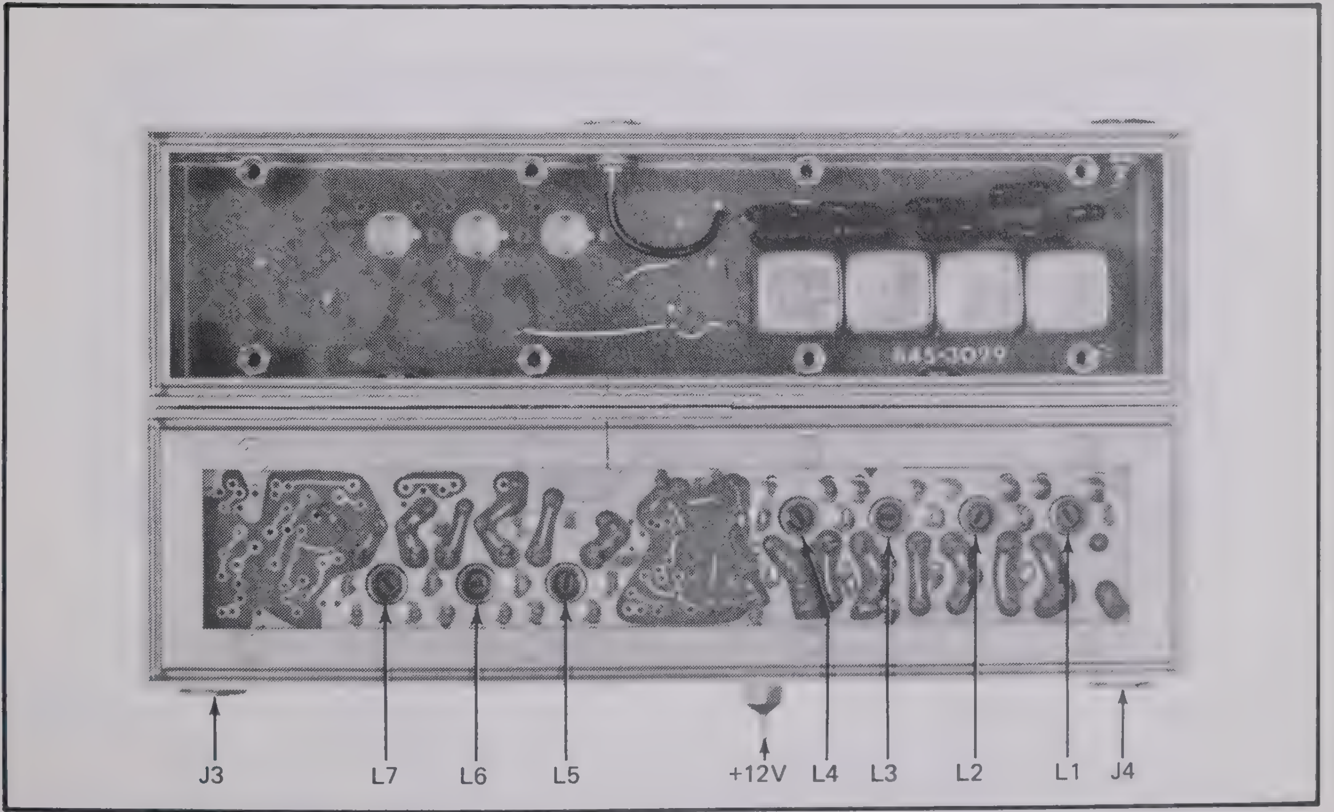

645-3029
J3
L7
L6
L5
+12V
L4
L3
L2
L1
J4

Figure 4-19. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4129-6)

c. Apply a 33 MHz signal having a level of –15 dbm into 50-ohms to J4.

d. Connect the input of an rf voltmeter and a 50-ohm load to J3.

e. Adjust L1 through L7 for maximum rms voltage at J3.

f. Increase the input signal level at J4 to –5 dbm into 50-ohms.

g. Adjust L4 and L7 for maximum rms voltage at J3. Minimum acceptable signal level is +1.0 dbm.

h. Disconnect the test equipment from the module and replace the enclosure cover.

4-67. Digit Shift Mixer (645-4135)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply +5 and +12 volts dc to the appropriate feed-thru terminals on the module, Connect the power supply common to the chassis of the module.

c. Apply a 33 MHz signal having a level of 60 millivolts rms to J1.

d. Apply a 4.05 MHz signal having a level of 100 millivolts rms into 50-ohms to J2.

e. Connect the input of an oscilloscope to TP1 and its ground lead to TP3. Use a 10:1 probe with the oscilloscope.

f. Adjust L3, L4, and L6 for a maximum 37 MHz signal at TP1. The 33 MHz input signal at J1 can be reduced temporarily to provide effective tuning of L3. The signal at TP1 should be 1.2, ±0.2 volts peak-to-peak.

g. Tune the signal generator connected to J2 from 4.0 to 4.1 MHz, observing that the signal at TP1 does not change more than ±10% of its average value. Reset the signal generator frequency to 4.05 MHz upon completion of this step.

h. Connect a sweep analyzer detector to J4.

i. Apply a 20 to 50 MHz sweep generator signal having a level of 70 millivolts rms into 50-ohms to J3.

j. Interconnect the sweep analyzer, sweep generator and oscilloscope to provide a sweep analyzer display having 10 MHz markers at 30 and 40 MHz.

k. Connect the oscilloscope probe to TP2, observing that a 30 to 40 MHz signal having peak-to-peak response to 0.7, ±0.2 volts is present.

l. Connect the oscilloscope probe to TP4 and adjust T2, L14, and L15 for maximum flat response between 40 and 41 MHz. After adjustment is completed, the observed signal level should be 1.25, ±0.25 volts with less than a 0.15 volt ripple between 40 and 41 MHz.

m. Connect the oscilloscope probe to TP5 and adjust L16 for maximum flat response between 40 and 41 MHz. The observed signal level should be 1.25, ±0.15 volts rms.

n. Tune the signal generator connected to J2 from 4.0 to 4.1 MHz, observing that the signal at TP5 does not change more than 0.15 volts of its average value.

o. Tune the signal generator connected to J2 to 4.0 MHz. The output signal at J4 should be –7 dbm, ±0.5 db, between 4.0 and 4.1 MHz. An overall output signal from 3.9 to 4.15 MHz should be present at J4.

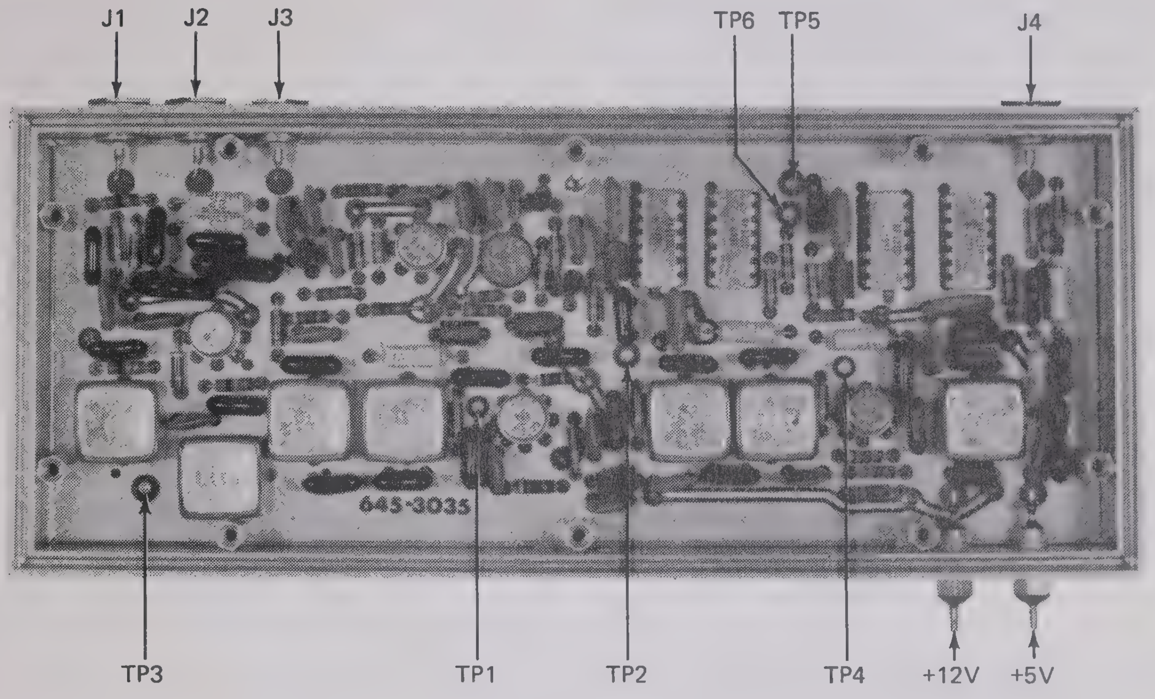
p. Decrease the input signals applied to J1, J2, and J3 by 10 db, ovserving that the signal level at J4 does not change. The output signal should also continue to operate over ±30% greater than the 4.0 to 4.1 MHz output range.

q. Disconnect the test equipment from the module and replace the enclosure covers.

4-68. 10:1 Divider No. 1 (645-4136-1, 2, 3)

a. Apply +5 and +12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

b. Apply a 20 to 50 MHz sweep generator signal having a level of –10 dbm into 50-ohms to J1.


J1
J2
J3
TP6
TP5
J4
645-3035
TP3
TP1
TP2
TP4
+12V
+5V

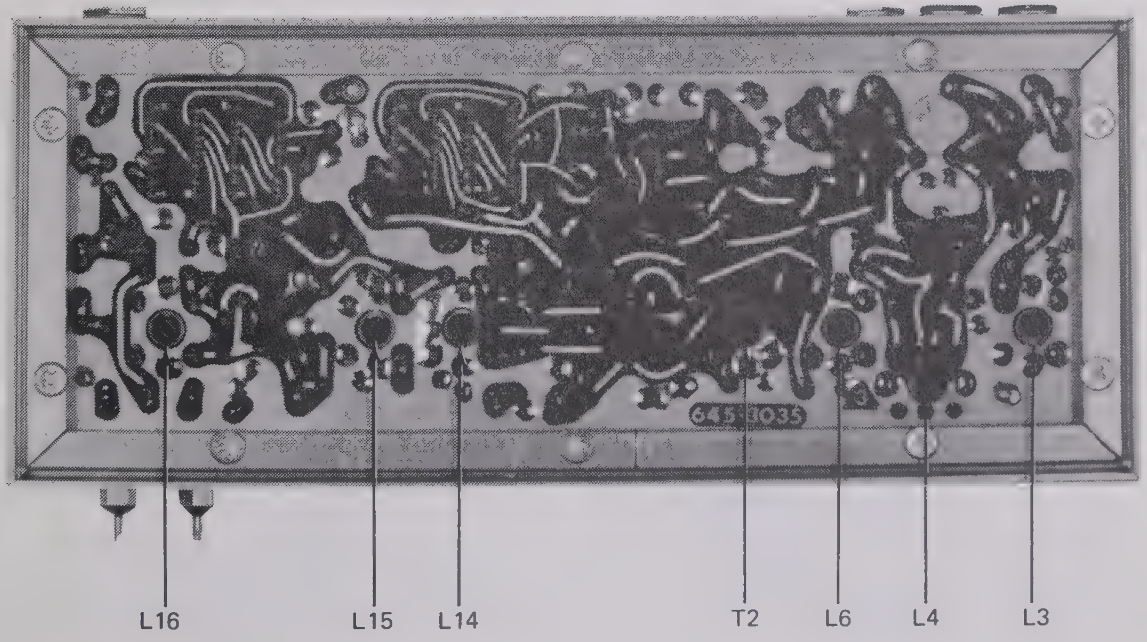

645-3035
L16
L15
L14
T2
L6
L4
L3

Figure 4-20. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4135)

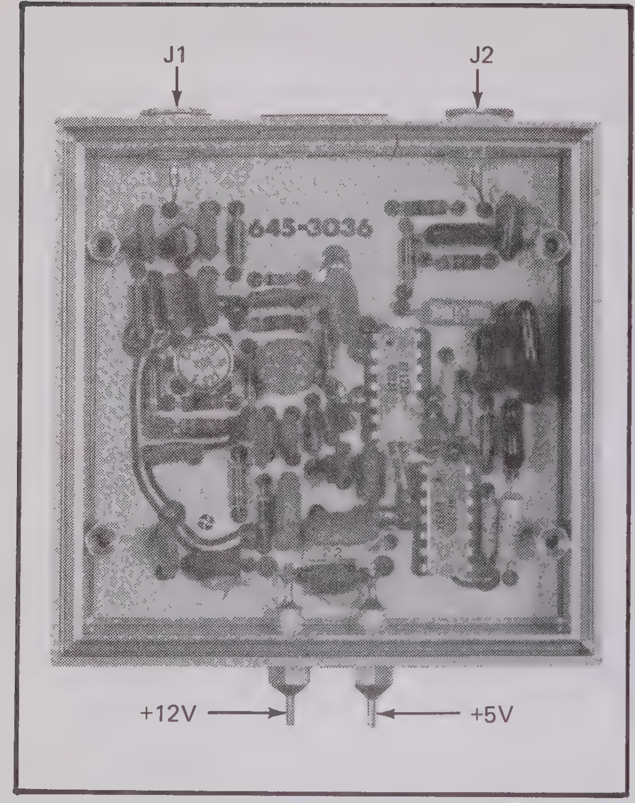


Figure 4-21. INPUT/OUTPUT CONNECTOR LOCATIONS (645-4136)

c. Interconnect the sweep generator with a sweep analyzer and connect the sweep analyzer input to J2.

d. The signal observed at J2 should be present from 2.5 to 4.5 MHz and have a level of –5, ±2 dbm at 3.5 MHz with a ripple of less than 1 db from 3.0 to 4.0 MHz.

e. Decrease the input signal applied to J1 by 20 db. An output frequency of 2.9 to 4.1 MHz should be present at J2.

f. Disconnect the test equipment from the module.

4-69. 10:1 Divider No. 2 (645-4149-1, 2)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit board.

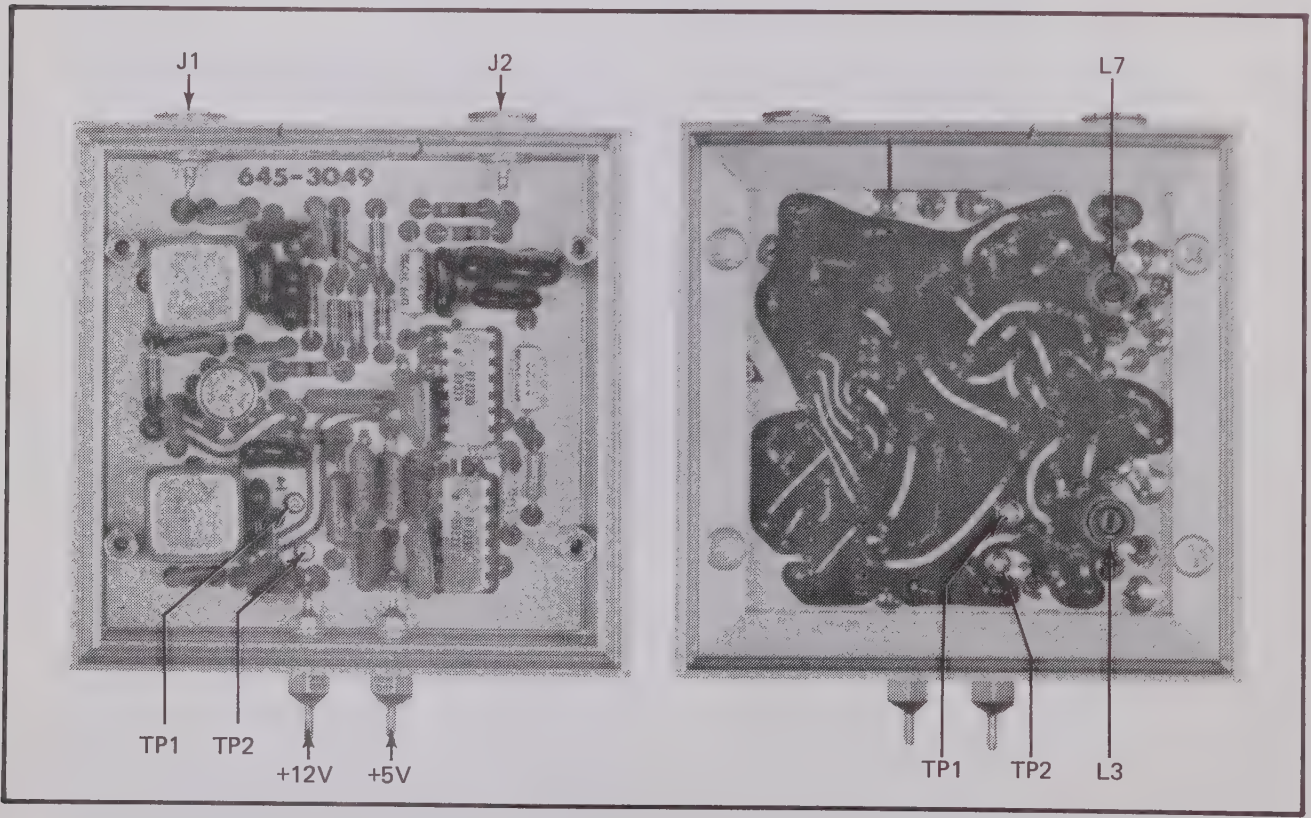


Figure 4-22. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4149)

b. Apply +5 and +12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 35 to 45 MHz sweep generator signal having a level of 70 millivolts rms into 50-ohms to J1.

d. Connect the input of a sweep analyzer to J2.

e. Interconnect the sweep generator, sweep analyzer, and an oscilloscope to provide a sweep display having 1 MHz frequency markers on the sweep analyzer.

f. Connect the oscilloscope input to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

g. Adjust L7 and L8 for maximum signal at TP1. The resulting signal should be 3.5,±0.5 volts peak-to-peak when the sweep generator signal is 40.5 MHz.

h. Disconnect the oscilloscope from the module.

i. Observe the sweep analyzer display. The output signal at J2 should be from 3.8 to 4.3 MHz and have a level of –6.5, ±2 db. The ripple between 4.0 to 4.1 MHz should be less than ±0.5 db.

j. Decrease the signal applied to J1 by 20 db, observing that the module output is present from 3.98 to 4.12 MHz.

k. Disconnect the test equipment from the module and replace the enclosure covers.

4-70 Digit Shift Mixer No. 1 and No. 2 (645-4137 and -4138)

4-71. DIGIT SHIFT MIXER NO. 1 (645-4137-1, 2)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 33 MHz signal having a level of 60 millivolts rms to J1.

d. Apply a 4.05 MHz signal having a level of 100 millivolts rms into 50-ohms to J2.

e. Connect the input of an rf voltmeter and a 50-ohm load to J3.

f. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

g. Adjust T1 for a maximum 4.05 MHz signal at TP1. The resulting signal should be 550, ±100 millivolts peak-to-peak.

h. Connect the oscilloscope probe to TP3 and adjust L1 for a maximum 33 MHz signal. The resulting signal should be 2.5, ±0.25 volts peak-to-peak. Disconnect the probe from the module upon completion of this step.

i. Adjust L8, L9, L10, and L11 for maximum rms voltage at J3. The output signal level should be –10,±2 dbm.

j. Tune the signal generator connected to J2 from 4.0 to 4.1 MHz, observing that the rms output voltage does not change more than ±1 db of the midband 4.05 MHz point.

k. Tune the signal generator connected to J1 from 32.9 to 33.1 MHz, observing that the rms output voltage does not change more than ±1 db of the midband 33 MHz point.

l. If necessary, readjust L1, L8, L9, L10 and L11 to obtain the output specified in steps j and k.

m. Disconnect the test equipment from the module and replace the enclosure covers.

4-72. DIGIT SHIFT MIXER NO. 2 (645-4138-1, 2)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

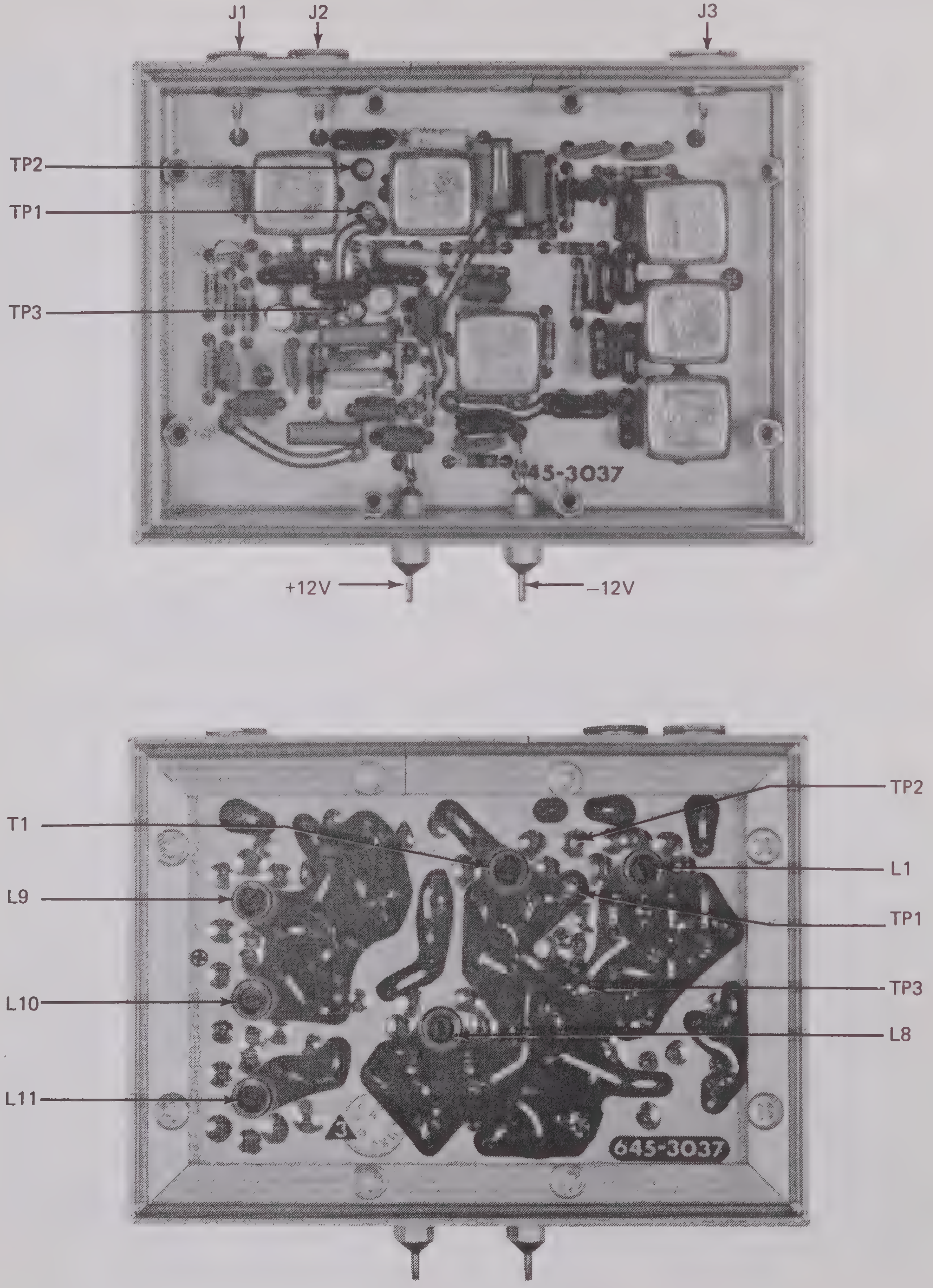

J1
J2
J3
TP2
TP1
TP3
645-3037
+12V
–12V
TP2
T1
L1
L9
TP1
TP3
L10
L8
L11
645-3037

Figure 4-23. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4137 and 4148)

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 37.05 MHz signal having a level of 70 millivolts rms into 50 ohms to J1.

d. Apply a 2 to 5 MHz sweep generator signal having a level of 100 millivolts rms into 50 ohms to J2.

e. Connect the input of a sweep analyzer to J3.

f. Interconnect the sweep generator, sweep analyzer, and an oscilloscope to provide a sweep display having 1 MHz frequency markers on the oscilloscope and sweep analyzer.

g. Connect the oscilloscope input to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

h. Adjust T1 for a maximum flat response from 3.0 to 3.9 MHz at TP1. The resulting signal should be 550, ±100 millivolts peak-to-peak.

i. Connect the oscilloscope probe to TP3 and adjust L1 for a maximum 37.05 MHz signal. The resulting signal should be 2.5, ±0.25 volts peak-to-peak.

j. Disconnect the oscilloscope from the module.

k. Adjust L8, L9, L10, and L11 for maximum flat response between 40 and 41 MHz at J3. The resulting output signal should be −10, ±2 dbm with a ripple of less than 1 db from the nominol. An overall output signal of 40 to 41 MHz, ±100 kHz should be observed.

l. Disconnect the test equipment from the module and replace the enclosure covers.

4-73. Digit Adder Mixer No. 1 (645-4139)

a. Remove the enclosure cover from the module.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 33 MHz signal having a level of 10 millivolts rms to J2.

d. Connect the input of a spectrum analyzer to J1. Tune the spectrum analyzer to 33 MHz and set its width to 3 MHz/cm.

e. Adjust L1 and L2 for a maximum 33 MHz signal at J1.

f. Apply a 33 MHz signal having a level of 70 millivolts rms to J2.

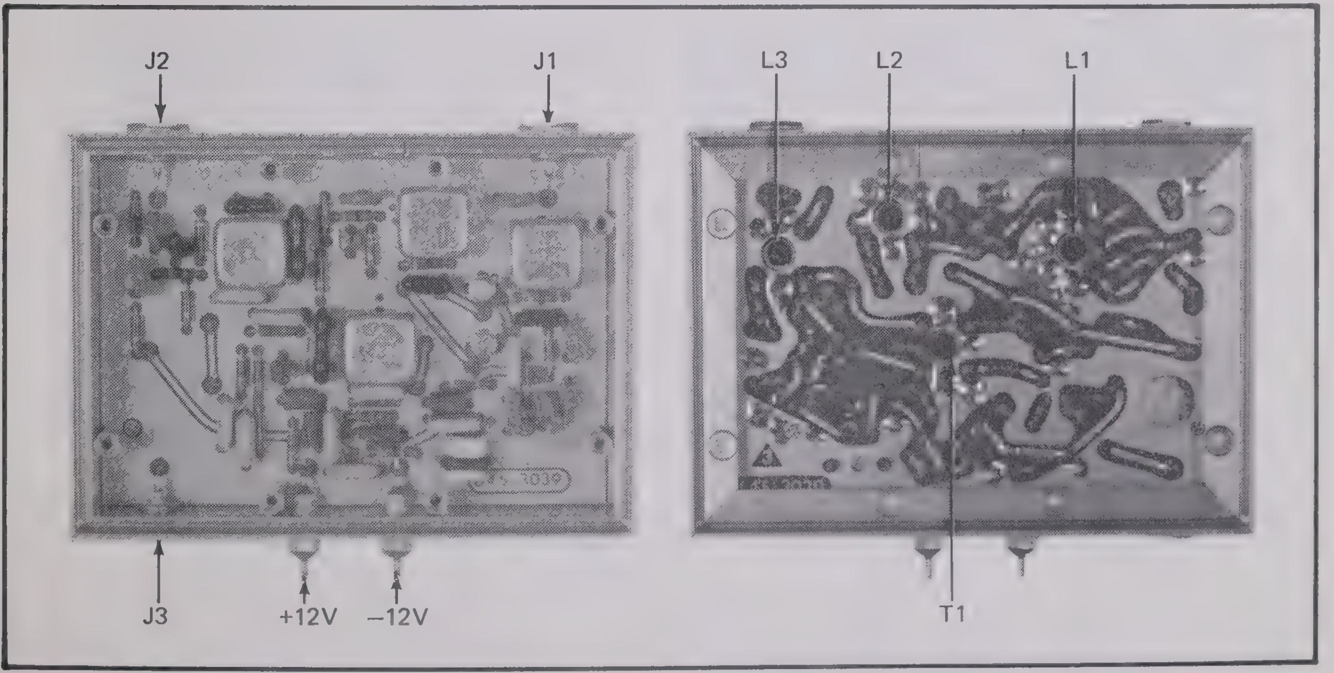


Figure 4-24. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4139)

g. Adjust R20 for minimum amplitude 33 MHz signal at J1.

h. Apply a 4 MHz signal having a level of 110 millivolts rms to J3.

i. Adjust T1 and L3 for a maximum 37 MHz signal at J1.

j. Record the level of the 37 MHz signal and tune the spectrum analyzer to 33 MHz. The 33 MHz signal must be at least 20 db below the 37 MHz signal.

k. Tune the spectrum analyzer to 29 MHz. The 29 MHz signal must be at least 20 db below the 37 MHz signal.

l. Disconnect the spectrum analyzer from the module.

m. Connect the input of an rf voltmeter and a 50-ohm load to J1. Minimum acceptable signal level is 80 millivolts rms.

n. Disconnect the test equipment from the module and replace the enclosure cover.

4-74. Digit Adder Mixer No. 2 (645-4141)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 37 MHz signal having a level of 55 millivolts rms to J2.

d. Connect the input of a spectrum analyzer to J1. Tune the spectrum analyzer to 37 MHz and set its width to 3 MHz/cm.

e. Adjust L6 and L7 for maximum 37 MHz signal at J1.

f. Adjust R25 for minimum amplitude 37 MHz signal at J1.

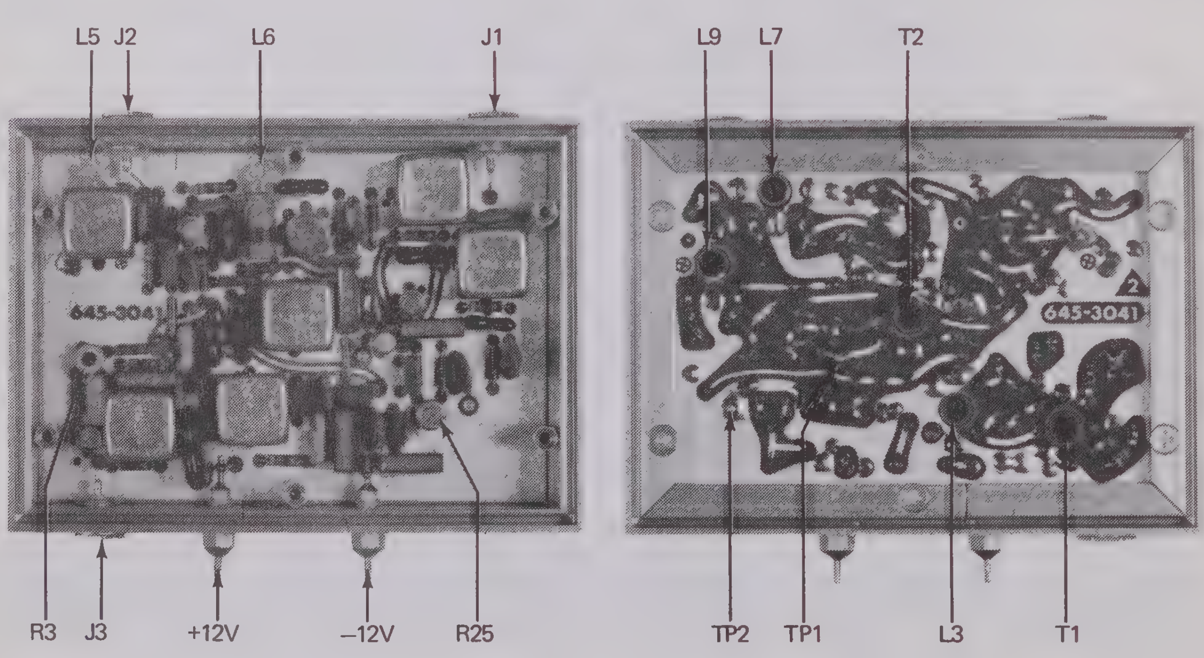


Figure 4-25. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4141)

g. Apply a 3.5 MHz sweep generator signal having a level of 125 millivolts rms to J3.

h. Tune the spectrum generator to 40.5 MHz and adjust T1, T2, and L9 for maximum amplitude 40.5 MHz signal at J1.

i. Apply a 6 MHz signal having a level of 125 millivolts rms to J3.

j. Tune the spectrum analyzer to 43 MHz and adjust L3 for minimum 43 MHz signal at J1.

k. Disconnect the spectrum analyzer from the module and connect the input of a sweep analyzer to J1.

l. Apply a 2 to 5 MHz sweep generator signal having a level of 125 millivolts rms to J3.

m. Interconnect the sweep generator and sweep analyzer to provide a 40 to 41 MHz display having 1 MHz frequency markers on the sweep analyzer.

n. Adjust T1 and T2 for a flat response between 40 to 41 MHz at J1. Peak-to-peak ripple must be less than 2 db.

o. Disconnect the sweep analyzer from the module and connect the input of an rf voltmeter and a 50-ohm load to J1.

p. Apply a 3.5 MHz signal having a level of 125 millivolts rms to J3.

q. Connect the input of an oscilloscope to TP1 and its ground lead to TP2. Use a 10:1 probe with the oscilloscope.

r. Adjust R3 for a 1.0 volt peak-to-peak signal at TP1. Disconnect the oscilloscope from the module upon completion of this step.

s. Adjust L5, L6, and L7 for maximum rms voltage at J1. The output level should be 125, ±25 millivolts rms.

t. Disconnect the 3.5 MHz input at J3 and adjust R25 for minimum rms voltage at J1. This output level must be at least 25 db below the output specified in step s.

u. Disconnect the test equipment from the module and replace the enclosure covers.

4-75. Digit Adder Filter No. 2 (645-4142)

a. Apply a 37.5 MHz signal having a level of 700 millivolts rms to J2.

b. Connect the input of a spectrum analyzer J1.

c. Adjust L2 for minimum 37.5 MHz signal at J1.

d. Apply a 44.5 MHz signal having a level of 700 millivolts rms to J2.

e. Adjust L3 for minimum 44.5 MHz signal at J1.

f. Connect a series 50-ohm adaptor to J1 and J2.

g. Apply a 39 to 42 MHz sweep generator signal having a level of 700 millivolts rms to J2.

h. Interconnect the sweep generator and a sweep analyzer to provide a 39 to 42 MHz display having 1 MHz frequency markers.

i. Connect the sweep analyzer input to J1.

j. Adjust L1 and L4 for maximum amplitude and flat response between 39.9 to 41.1 MHz at J1. Peak-to-peak ripple must be less than 1 db. Maximum insertion-loss of this module is 7 db.

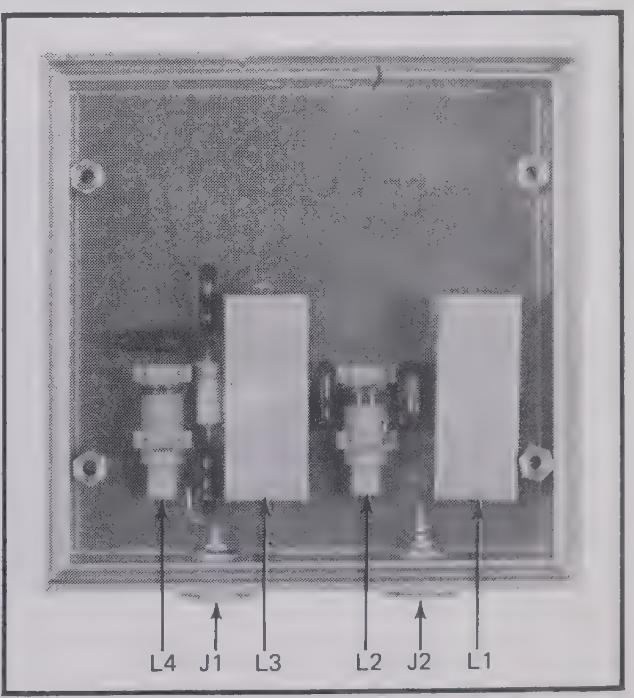


Figure 4-26. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4142)

k. Disconnect the test equipment from the module.

4-76. Digit Adder Filter No. 3 (645-4143)

a. Remove the enclosure covers from the module.

NOTE!

Ensure that adequate rf grounding is provided on the land-pattern side of the printed circuit assembly.

b. Apply ±12 volts dc to the appropraite feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

c. Apply a 37 MHz signal having a level of 50 millivolts rms to J1.

d. Connect the input of a spectrum analyzer to TP1 and its ground lead to TP2.

e. Adjust L5 for minimum amplitude 37 MHz signal at TP1.

f. Apply a 44 MHz signal having a level of 50 millivolts rms to J1.

g. Adjust L6 for minimum amplitude 44 MHz signal at TP1.

h. Apply a 40.5 MHz signal having a level of 50 millivolts rms to J1.

i. Adjust L4 and L7 for maximum amplitude 40.5 MHz signal at TP1.

j. Disconnect the spectrum analyzer from the module.

k. Apply a 39 to 42 MHz sweep generator signal having a level of 50 millivolts rms to J1.

l. Interconnect the sweep generator and a sweep analyzer to provide a 39 to 42 MHz display having 1 MHz frequency markers on the sweep analyzer.

m. Connect the sweep analyzer detector input to J2.

n. Adjust L8 and L9 for maximum amplitude and flat response between 39.9 to 41.1 MHz at J2. Peak-to-peak ripple must be less than 0.5 db.

o. Install the enclosure covers and repeat step n.

p. Disconnect the sweep analyzer from the module and connect the input of an rf voltmeter and a 50-ohm load to J2.

q. Apply a 40.5 MHz signal having a level of 50 millivolts rms to J1.

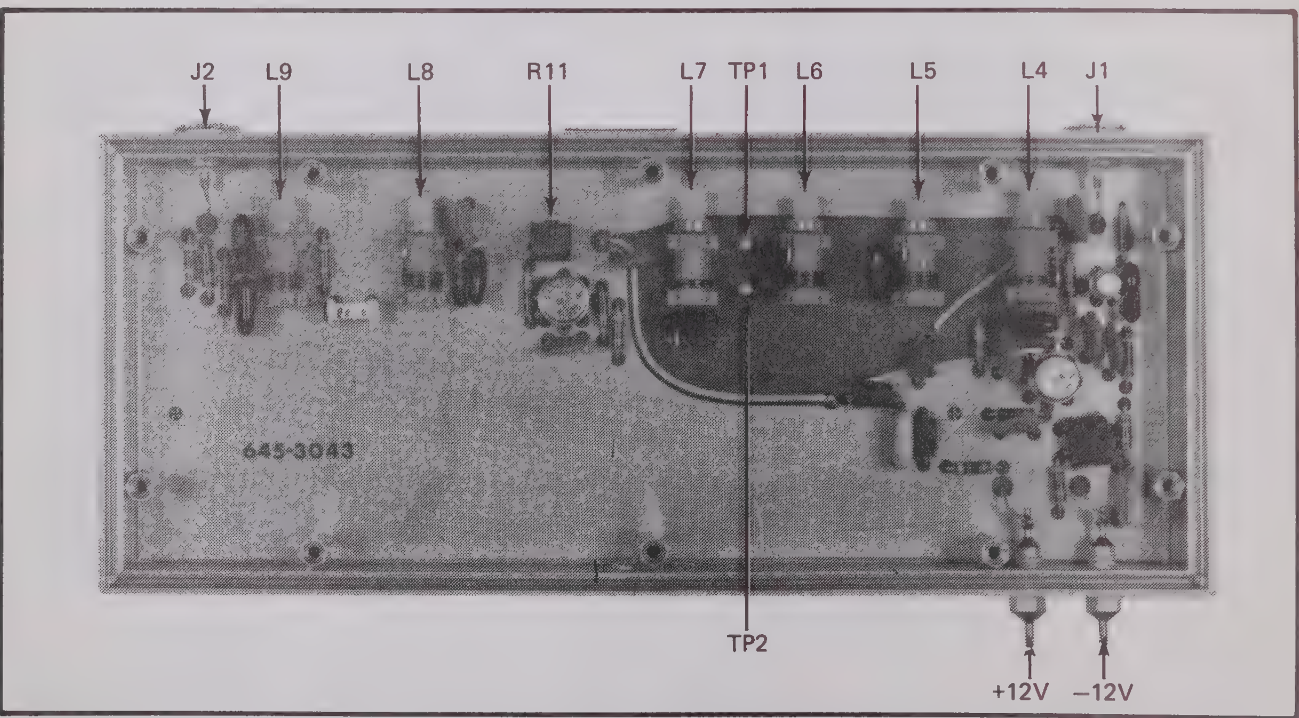


Figure 4-27. ADJUSTMENT, TEST POINT, AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4143)

r. Adjust R11 for a 80 millivolt rms output signal at J2.

s. Decrease the input signal level at J1 by 3 db, observing that the output signal at J2 does not change more than 0.5 db.

t. Disconnect the test equipment from the module.

4-77. Oscillator (645-4185)

a. Apply –12 volts dc to the appropriate feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Connect the input of an rf voltmeter, frequency counter, and a 50-ohm load to J1. Terminate J2 into a 50-ohm load.

c. Connect the input of a dc differential voltmeter to J3. Shunt the voltmeter input with a 1k ohm resistor.

d. Perform the appropriate control feed-thru connections and adjustments contained in Table 4-20. Control feed-thru terminal locations are illustrated in Figure 4-28.

e. Disconnect the test equipment from the module.

4-78. Input Mixer (645-4187)

a. Apply –12 volts dc to the feed-thru terminal located on the module. Connect the power supply common to the chassis of the module.

b. Apply a 30 MHz signal through a series 50-ohm resistor having a level of –10 dbm into 100-ohms to J1.

Table 4-20. OUTPUT FREQUENCY AND DC LEVEL ADJUSTMENT (645-4185)

CONTROL FEED-THRU TERMINAL (+12 Volts DC)	J1 AND J2 OUTPUTS			DC OUTPUT ADJUSTMENT LEVEL J3	
	ADJUSTMENT	FREQUENCY (±50 kHz)	OUTPUT LEVEL (±3 db)		
0	A1	410 MHz	–13 dbm	R3	–8.5 vdc
1	A2	400 MHz	–13 dbm	R15	–8.5 vdc
2	A3	390 MHz	–13 dbm	R24	–8.5 vdc
3	A4	380 MHz	–13 dbm	R33	–8.5 vdc
4	A5	370 MHz	–13 dbm	R42	–8.5 vdc

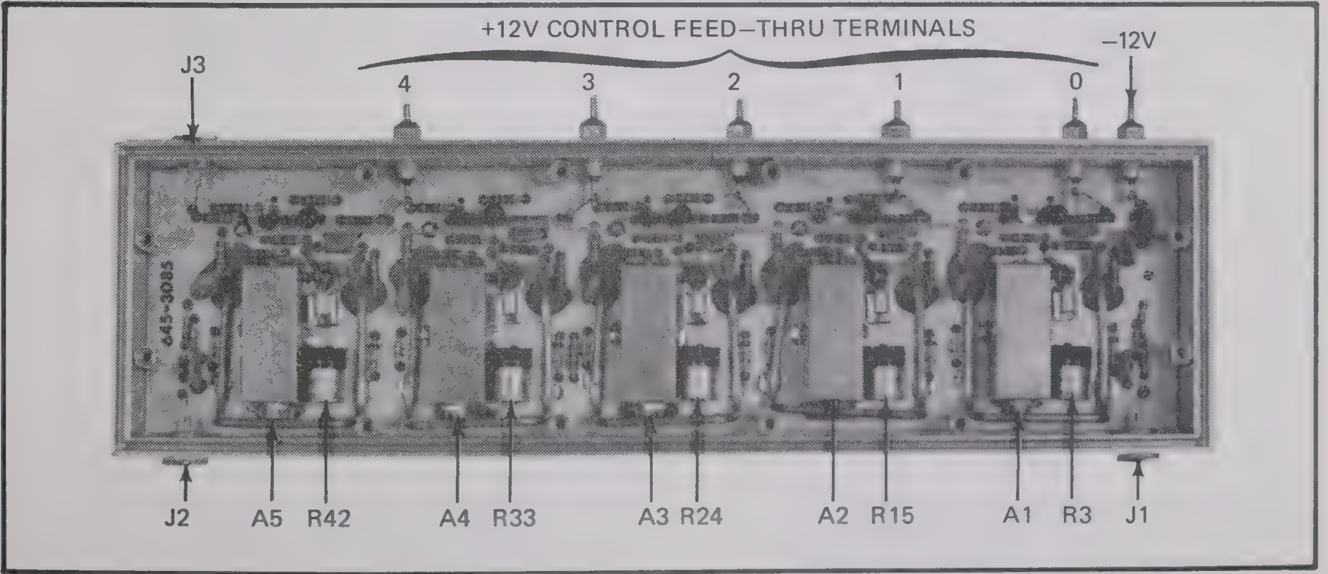


Figure 4-28. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4185)

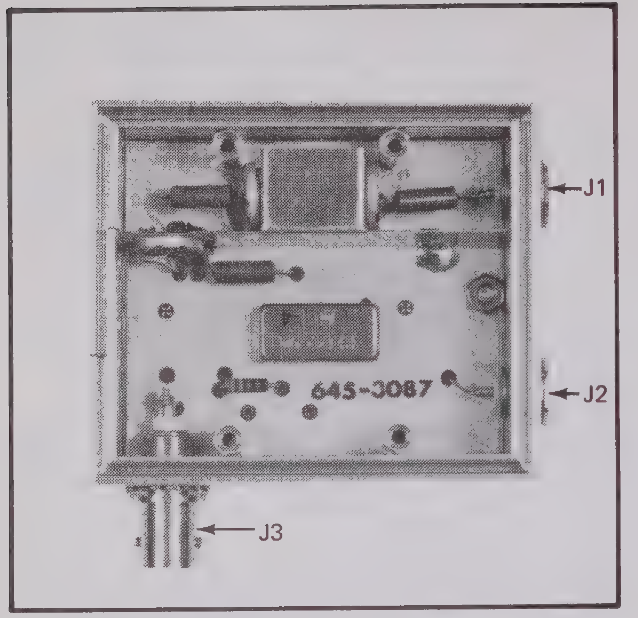


Figure 4-29. INPUT/OUTPUT CONNECTOR LOCATIONS (645-4187)

c. Apply a 370 MHz signal having a level of +7 dbm into 50-ohms to J2.

d. Connect the input of a spectrum analyzer (tuned to the same frequency as J2) to J3. Establish a +7 dbm reference at the frequency of J2 on the spectrum analyzer display.

e. Observe the spectrum analyzer display for the following signal conditions:

The carrier signal (J2 frequency) should be more than 40 db below the +7 dbm reference.

The upper and lower sidebands (sum and difference of J1 and J2) should be not less than −18 dbm.

f. Repeat steps b through e, substituting the following input frequencies at J1 and J2.

J1	J2
40 MHz	380
50 MHz	390
60 MHz	400
70 MHz	410

g. Disconnect the test equipment from the module.

4-79. Three Stage Amplifier Modules (645-4186, –4188, –4195, –4196)

4-80. 390 MHz THREE STAGE AMPLIFIER (645-4186)

a. Apply −12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Apply a 360 to 420 MHz sweep generator signal having a level of −30 dbm into 50-ohms to J1.

c. Interconnect the sweep generator and a sweep analyzer to provide 360 to 420 MHz display having 10 MHz frequency markers on the sweep analyzer.

d. Connect the sweep analyzer input to J2.

e. Set R16 to the center of its adjustment range.

f. Adjust A1, A2, and A3 for a maximum flat output between 370 to 410 MHz at J2.

g. Apply a 360 to 420 MHz sweep generator signal having a level of −10 dbm into 50-ohms to J1.

h. Adjust R16 for a 390 MHz output signal having a level of +7, ±0.5 dbm at J2.

i. Adjust A3 to equalize the 370 to 410 MHz outputs at J2. These outputs must not be more than 2 db below the 390 MHz mid-band level.

j. Decrease the input signal level at J1 to −30 dbm, observing that the output signal at J2 does not change more than 14 db.

k. Disconnect the test equipment from the module.

4-81. 380 MHz THREE STAGE AMPLIFIER (645-4195)

a. Apply −12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Apply a 380.5 MHz signal having a level of −30 dbm into 50-ohm to J1.

c. Connect the input of an rf voltmeter and a 50-ohm load to J2.

d. Set R16 to the center of its adjustment range.

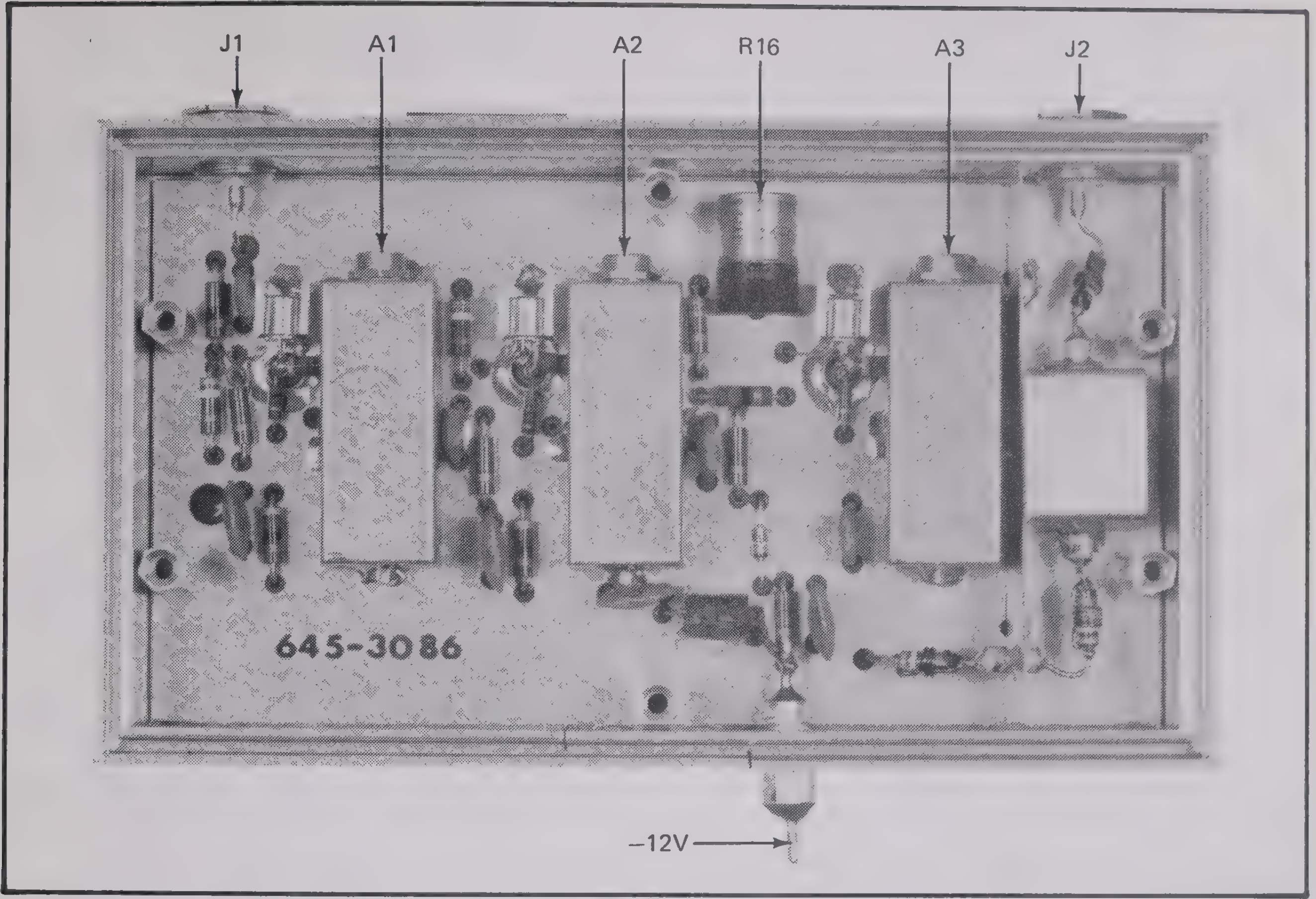


Figure 4-30. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4186, 4188, 4195, 4196)

e. Adjust A1, A2, and A3 for maximum rms voltage at J2.

f. Apply a 380.5 MHz signal having a level of –10 dbm into 50-ohms to J1.

g. Adjust R16 for an output signal level of +7 dbm at J2.

h. Tune the signal generator to 379.5 MHz and then to 381.5 MHz. Record the output signal level at J2 for each input frequency.

i. Adjust A3 to equalize the output levels recorded in step h.

j. Decrease the signal level applied to J1 to –30 dbm into 50-ohms, observing that the output signal at J2 does not change more than 10 db.

k. Disconnect the test equipment from the module.

4-82. 340 AND 415 MHz THREE STAGE AMPLIFIERS (645-4188 and -4196)

4-83. Alignment of the 645-4188 or 645-4196 modules is accomplished using the following procedure and the appropriate input frequency contained in Table 4-21.

Table 4-21. INPUT FREQUENCIES AND LEVELS (645-4188 and -4196)

MODULE	INPUT FREQUENCY (J1)	INPUT SIGNAL LEVEL
645-4188	340 MHz	–40 dbm into 50-ohms
645-4196	415 MHz	–30 dbm into 50-ohms

a. Apply –12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Apply the input signal specified in Table 4-21 to J1.

c. Connect the input of an rf voltmeter and a 50-ohm load to J2.

d. Set R16 to the center of its adjustment range.

e. Adjust A1, A2, and A3 for maximum rms voltage at J2.

f. Increase the signal level at J1 by 20 dbm into 50-ohms.

g. Adjust R16 for an output signal level of +7 dbm at J2.

h. Tune the signal generator connected to J1 to the input frequencies specified in Table 4-22 and record the resultant output signal levels at J2.

Table 4-22. TEST INPUT FREQUENCIES AT J1 (645-4188 and -4196)

MODULE	INPUT FREQUENCIES AT J1
645-4188	339 MHz — 341 MHz
645-4196	409 MHz — 421 MHz

i. Adjust A3 to equalize the output signal levels recorded in step h.

j. Decrease the signal level at J1 by 20 dbm into 50-ohms, observing that the output signal level at J2 does not change more than 10 db for the 645-4188 module and 14 db for the 645-4196 module.

k. Disconnect the test equipment from the module.

4-84. First and Second Up Convertors (645-4189 and -4190)

4-85. FIRST UP CONVERTOR (645-4189)

a. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

b. Apply a 35 to 45 MHz sweep generator signal having a level of –10 dbm into 50-ohms to J1.

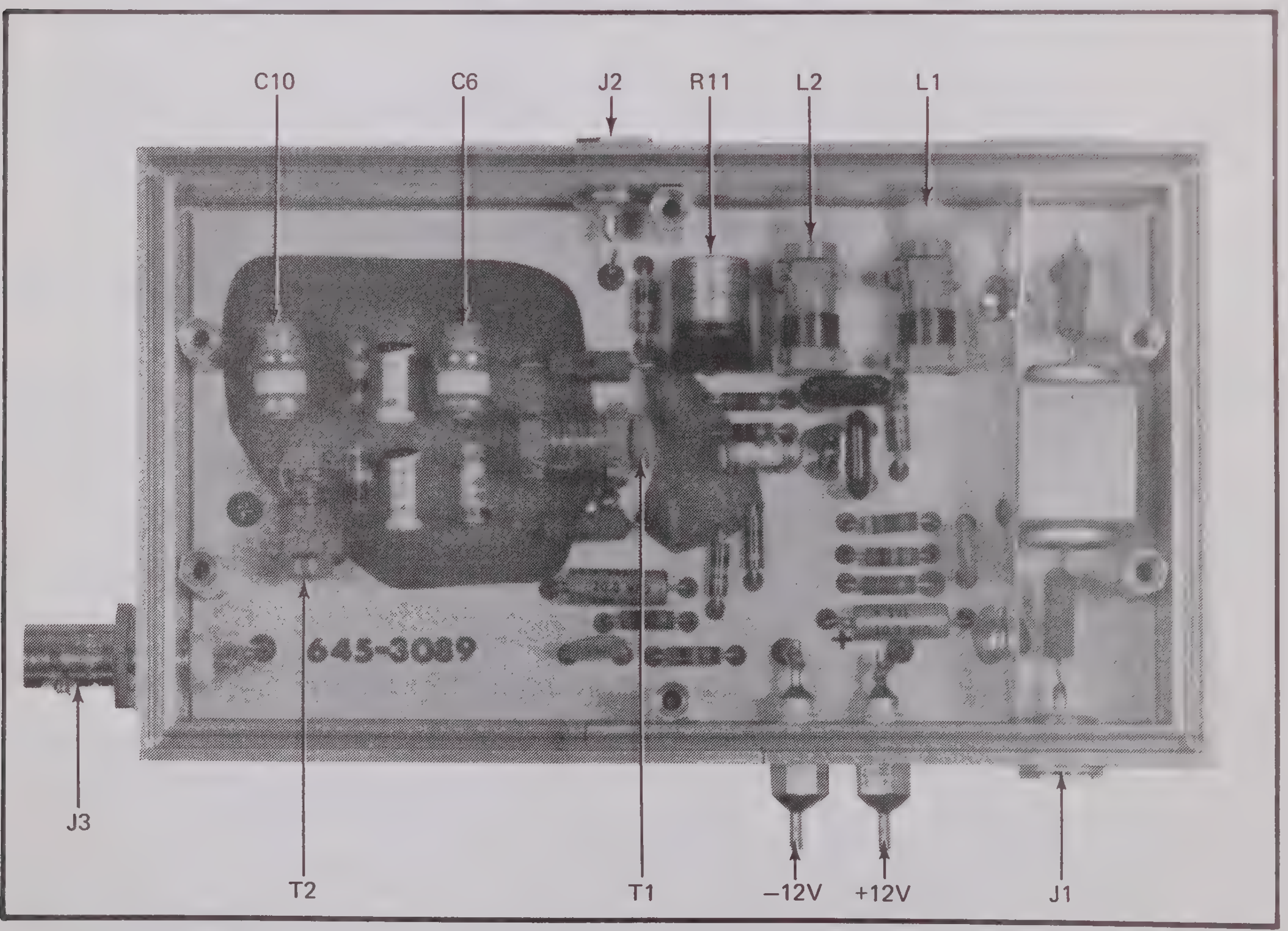


Figure 4-31. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4189 and 4190)

c. Apply a 340 MHz signal having a level of +7 dbm into 50-ohms to J2.

d. Interconnect the sweep generator and a sweep analyzer to provide a 380 to 381 MHz display having 1 MHz frequency markers on the sweep analyzer.

e. Connect the sweep analyzer input to J3.

f. Adjust L1, L2, C6, and C10 for maximum 380.5 MHz signal at J3. Minimum acceptable signal level is –12 dbm.

g. Connect a spectrum analyzer to J3. Tune the spectrum analyzer to 340 MHz and adjust R11 for minimum amplitude 340 MHz signal at J3. Disconnect the spectrum analyzer.

h. Repeat step f until the skirts at 380 and 381 MHz are within 0.5 db of each other.

i. Tune the signal generator connected to J2 from 339.5 to 340.5 MHz, observing that the output signal level between 379.5 and 381.5 MHz at J3 does not change more than 0.5 db on the sweep analyzer. If necessary, repeat steps f through i until the specified results are obtained.

j. Apply a 40.5 MHz signal having a level of –10 dbm to J1.

k. Tune the spectrum analyzer to 340 MHz and adjust R11 for minimum 340 MHz signal at J3. This signal should be at least 25 db below the 380 to 381 MHz output signal level.

l. Disconnect the test equipment from the module.

4-86. SECOND UP CONVERTOR (645-4190)

a. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

b. Apply a 25 to 45 MHz sweep generator signal having a level of –10 dbm into 50-ohms to J1.

c. Apply a 380.5 MHz signal having a level of +7 dbm into 50-ohms to J2.

d. Interconnect the sweep generator and sweep analyzer to provide a 410 to 420 MHz display having 10 MHz frequency markers on the sweep analyzer.

e. Connect the sweep analyzer input to J3.

f. Adjust L1, L2, C6, and C10 for maximum 415 MHz signal at J3. Minimum acceptable signal level is –15 dbm.

g. Connect a spectrum analyzer to J3. Tune the spectrum analyzer to 380.5 MHz and adjust R11 for minimum amplitude 380.5 MHz signal at J3. Disconnect the spectrum analyzer.

h. Repeat step f unitl the skirts at 410 and 420 MHz are within 0.5 db of each other.

i. Tune the signal generator connected to J2 from 379 to 382 MHz, observing that the output signal level between 409 and 421 MHz at J3 does not change more than 0.5 db on the sweep analyzer. If necessary, repeat steps f through i until the specified results are obtained.

j. Apply a 35 MHz signal having a level of –10 dbm to J1.

k. Connect a spectrum analyzer to J3. Tune the spectrum analyzer to 380.5 MHz and adjust R11 minimum 380.5 MHz signal at J3. This signal must be at least 25 db below the 410 to 420 MHz output signal level.

l. Disconnect the test equipment from the module.

4-87. Output Mixer (645-4191)

a. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

b. Apply a 410 MHz signal having a level of +3 dbm into 50-ohms to J3.

c. Apply a 402 to 428 MHz sweep generator signal having a level of +7 dbm into 50-ohms to J2.

d. Connect a 20-ohm resistor in series with the output connector J1.

e. Interconnect the sweep generator and sweep analyzer to provide a 0 to 50 MHz display having 10 MHz frequency markers on the wave analyzer for a –20 dbm mid-scale 1 db/cm display.

f. Connect the sweep analyzer input to the resistor attached to J1.

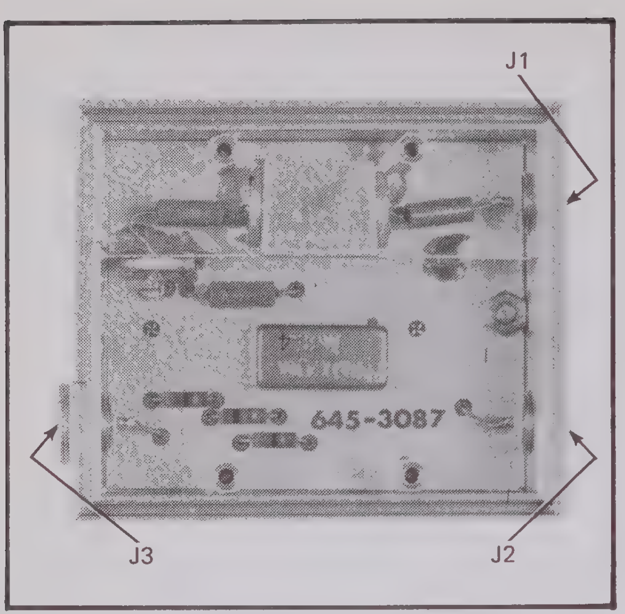


Figure 4-32. INPUT/OUTPUT CONNECTOR LOCATIONS (645-4191)

g. Set the signal generator connected to J3 to successive frequencies of 410, 400, 390, 380, and 370 MHz (level to be +3, ±0.1, dbm), observing that the 0 to 50 MHz output signal at J1 has a level of –22.5, ±1, dbm. Output signal level variation shall not be greater than ±0.25 db over any 10 MHz band.

h. Disconnect the sweep analyzer from the module.

i. Connect the input of a spectrum analyzer to the resistor attached to J1. Set the spectrum analyzer for a –10 dbm full-scale display.

j. Apply a 370 MHz signal having a level of +3 dbm to J3.

k. Apply a 415 MHz signal having a level of +7 dbm to J2.

l. Tune the spectrum analyzer to 45 MHz, observing that the 45 MHz output signal at J1 has a level of –22, ±2 dbm. All harmonics should be at least 40 db below the 45 MHz output. All carrier feed-through components must be at least 60 db below the 45 MHz output.

m. Disconnect the test equipment from the module.

4-88. Output Amplifier (645-4193)

a. Apply ±12 volts dc to the appropriate feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Short J2 to ground.

c. Connect the inputs of a dc differential voltmeter to J3.

d. Adjust R9 for 0, ±2 millivolts at J3.

e. Remove the short at J2 and connect the input of the dc differential voltmeter to J2.

f. Adjust R17 for 0, ±1 millivolts at J2.

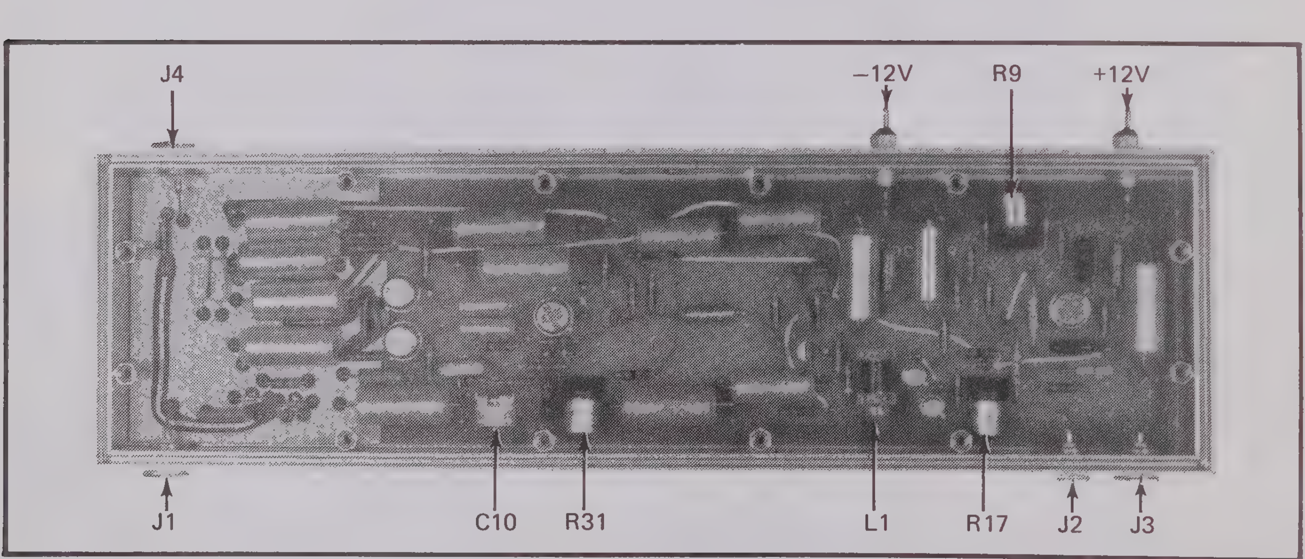


Figure 4-33. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4193)

g. Disconnect the dc differential voltmeter from the module.

h. Connect the input of an rf voltmeter and a 10 db attenuator to J2.

i. Apply a 10 to 70 MHz sweep generator signal to the input of the 10 db attenuator.

j. Adjust the sweep generator output level to establish a 21 millivolt rms input signal (20 MHz CW) at J2.

k. Connect the sweep analyzer detector to J1.

l. Interconnect the sweep generator and sweep analyzer to provide a 10 to 70 MHz display having 10 MHz frequency markers on the sweep analyzer.

m. Adjust R31, C10, and L1 for maximum flatness of the 10 to 50 MHz signal at J1. The signal amplitude should be +13 dbm and the ripple should not exceed ±0.2 db.

n. Disconnect the test equipment from the module. Do not disconnect the power source from the module.

o. Connect the input of a spectrum analyzer through a sereis 10 db attenuator to J1.

p. Apply the 19 millivolt rms input signals contained in Table 4-23 to J2, observing that the second and third harmonics of the signals are at least 30 db down at J1.

Table 4-23. HARMONIC CHECKS (645-4193)

INPUT SIGNAL J2 (MHz)	HARMONIC OUTPUTS AT J1 (MHz)
10	20, 30
20	40, 60
30	60, 90
40	80, 120
50	100, 150

q. Repeat step n.

r. Connect the rf voltmeter input and a 50-ohm load to J1.

s. Apply the 21 millivolt rms input signals contained in Table 4-24, observing that a 1.0, ±0.05 volt rms output is present at J1.

Table 4-24. OUTPUT LEVEL CHECKS (645-4193)

INPUT SIGNAL AT J2 (MHz)
.5
1
5
10

t. Connect the rf voltmeter input and a 50-ohm load to J3.

u. Remove the input signal at J2.

v. Apply a 50 kHz signal having a level of 21 millivolts rms to J2, observing that a 110, ±6 millivolt rms output is present at J3.

w. Disconnect the test equipment from the module.

4-89. AGC Amplifier (645-4192)

a. Apply −12 volts dc to the feed-thru terminal on the module. Connect the power supply common to the chassis of the module.

b. Connect a 560 ohm resistor between the −12V feed-thru and J3.

c. Apply a 360 to 420 MHz signal having a level of −30 dbm into 50-ohms to J1.

d. Interconnect the sweep generator and a sweep analyzer to provide a 370 to 410 MHz display having 10 MHz frequency markers on the sweep analyzer.

e. Connect the sweep analyzer input to J4.

f. Adjust A1, A2, and A3 for maximum 400 MHz output at J4.

g. Apply a 360 to 420 MHz signal having a level of −10 dbm into 50-ohms to J1, observing that the output signal at J4 has a level of 3, ±2 dbm.

h. Adjust A3 to equalize the 370 to 410 MHz output signals at J4. The level of these signals should be within ±0.5 db of the mid-band 390 MHz signal. Record the output signal level at J4.

i. Apply a 360 to 420 MHz signal having a level of −30 dbm to J1, observing the output signal level at J4 does not change more than 14 db.

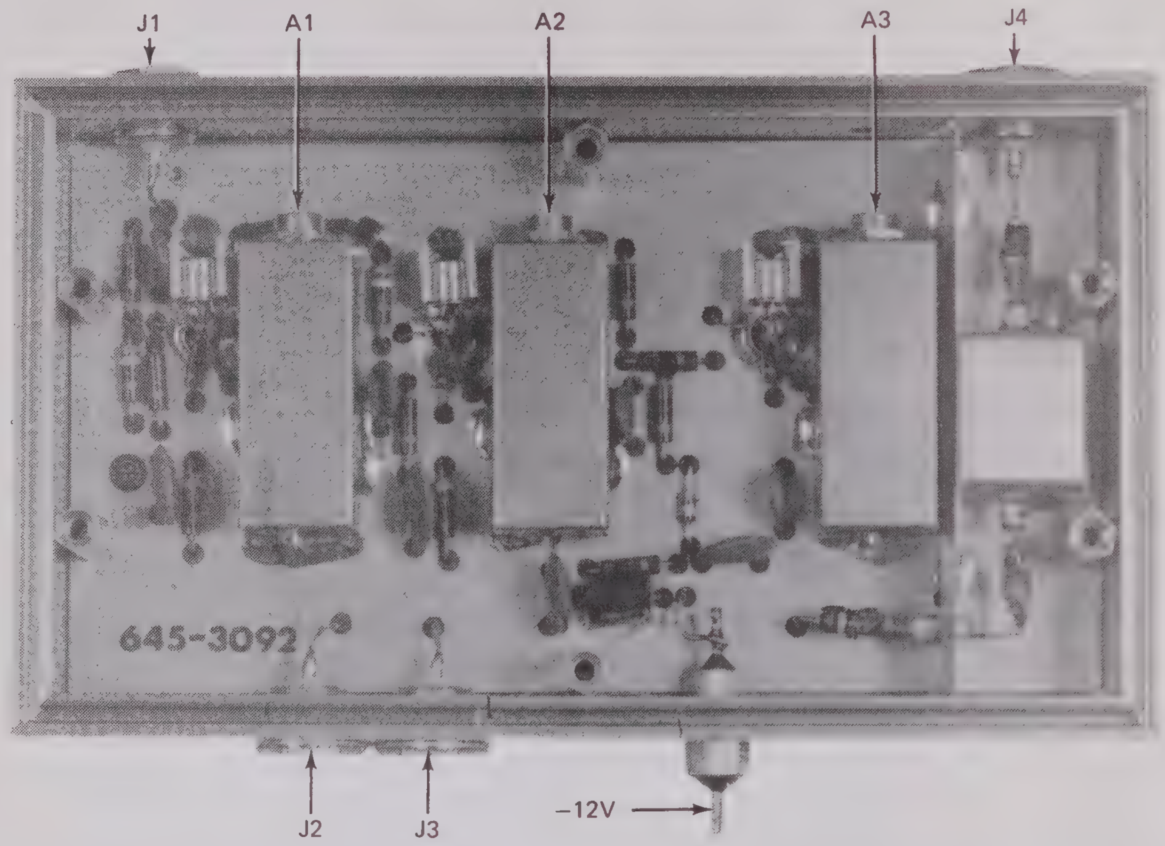


Figure 4-34. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4192)

j. Disconnect the 560 ohm resistor from J3, observing that the output signal level at J4 decreases by at least 20 db.

k. Disconnect the test equipment from the module.

4-90. Amplitude Control (645-4194)

a. Apply ±12 volts dc to the appropriate feed-thru terminals on the module. Connect the power supply common to the chassis of the module.

b. Apply –7 volts dc through an ammeter to J3. Connect the ammeter + terminal to J3.

c. Connect a 50-ohm load to J1.

d. Connect a variable dc voltage source having a level of zero volts dc to J2, observing that a zero current indication is indicated by the ammeter connected to J3.

e. Apply +12 volts dc to MANUAL ALC GATE INPUT feed-thru terminal. This terminal is the nearest terminal to the corner of the module.

f. The ammeter connected to J3 should indicate +2.5, ±1.0 milliamperes.

g. Set the dc voltage applied to J2 at +0.03 volts dc, observing that the ammeter indication decreases to less than +0.5 milliamperes.

h. Vary the dc control voltage applied to J2 between plus and minus 1.0 volt dc, observing that the ammeter indication is –4, ±1.0, and +9, ±1.0, milliamperes, respectively

i. Disconnect the variable dc voltage source from J2 and connect this voltage source to J4. Disconnect the +12 volts dc from the MANUAL GATE INPUT terminal and apply this voltage to the EXT AM GATE INPUT terminal. This terminal is adjacent to the +12V feed-thru.

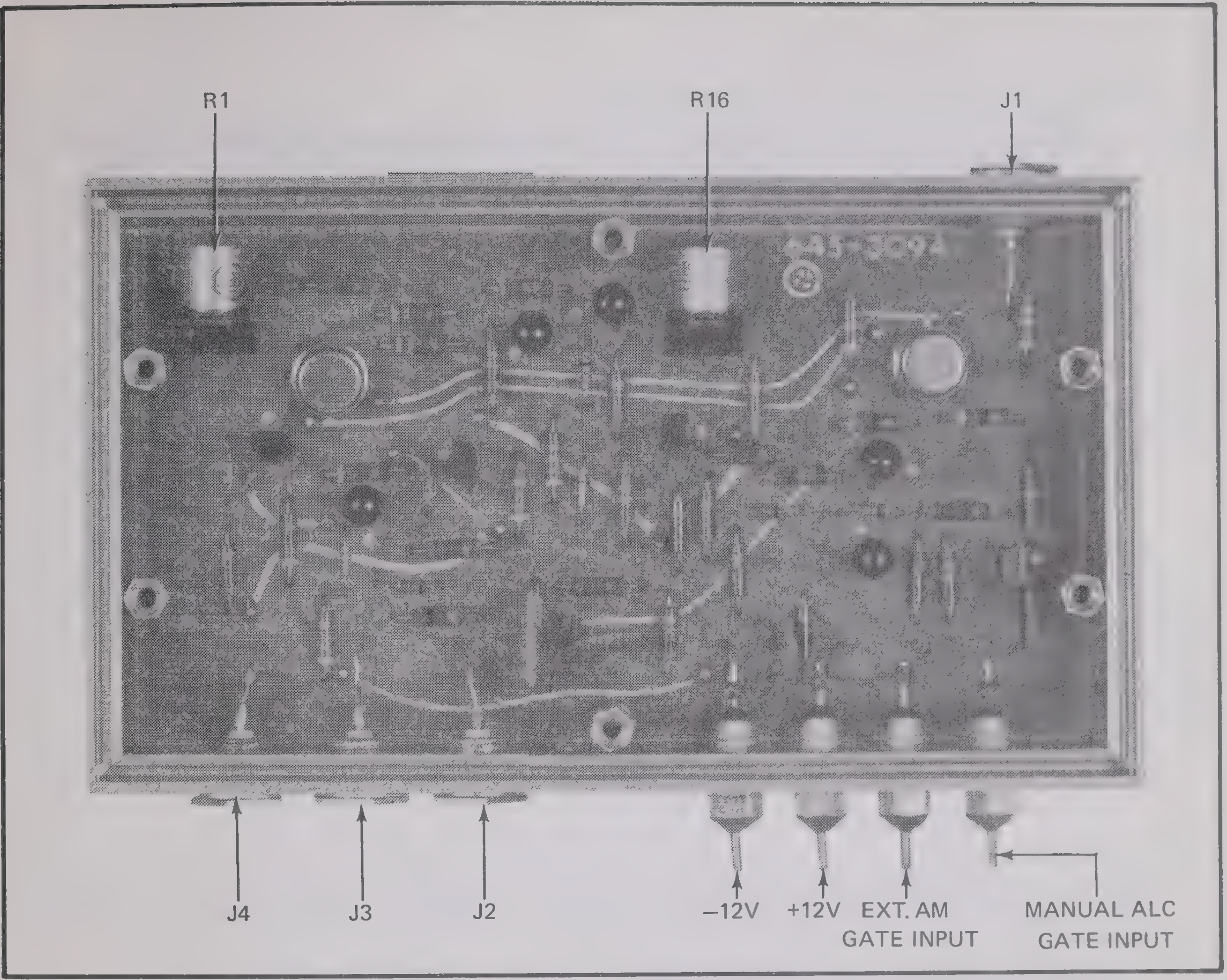


Figure 4-35. ADJUSTMENT AND INPUT/OUTPUT CONNECTOR LOCATIONS (645-4194)

j. Apply zero volts dc to J4.

k. Adjust R16 for a +2 milliampere output at J3.

l. Apply +1.4 volts dc to J4.

m. Adjust R1 for a zero current output at J3.

n. Repeat steps j through m until the desired results are obtained.

o. Apply –5 volts dc to J4, observing that the output current at J3 is +9, ±1.0 milliamperes.

p. Disconnect the test equipment from the module.

4-91. Power Supply (645-4063)

a. Remove ac power from the Model 645A.

b. Remove the screws that secure the power supply assembly to the synthesizer rear panel.

c. Pull the power supply assembly approximately four inches away from the rear panel of the synthesizer.

d. Remove the screws that secure the inside cover of the power supply and then remove the cover.

e. Ensure that none of the power supply circuitry is touching the synthesizer chassis and then energize the Model 645A.

f. Connect the input of a dc differential voltmeter to TP2 and its common lead to TP1 of the power supply. Ensure that the voltmeter common is isolated from ground.

g. Adjust R10 for –17, ±0.5 volts dc to TP2.

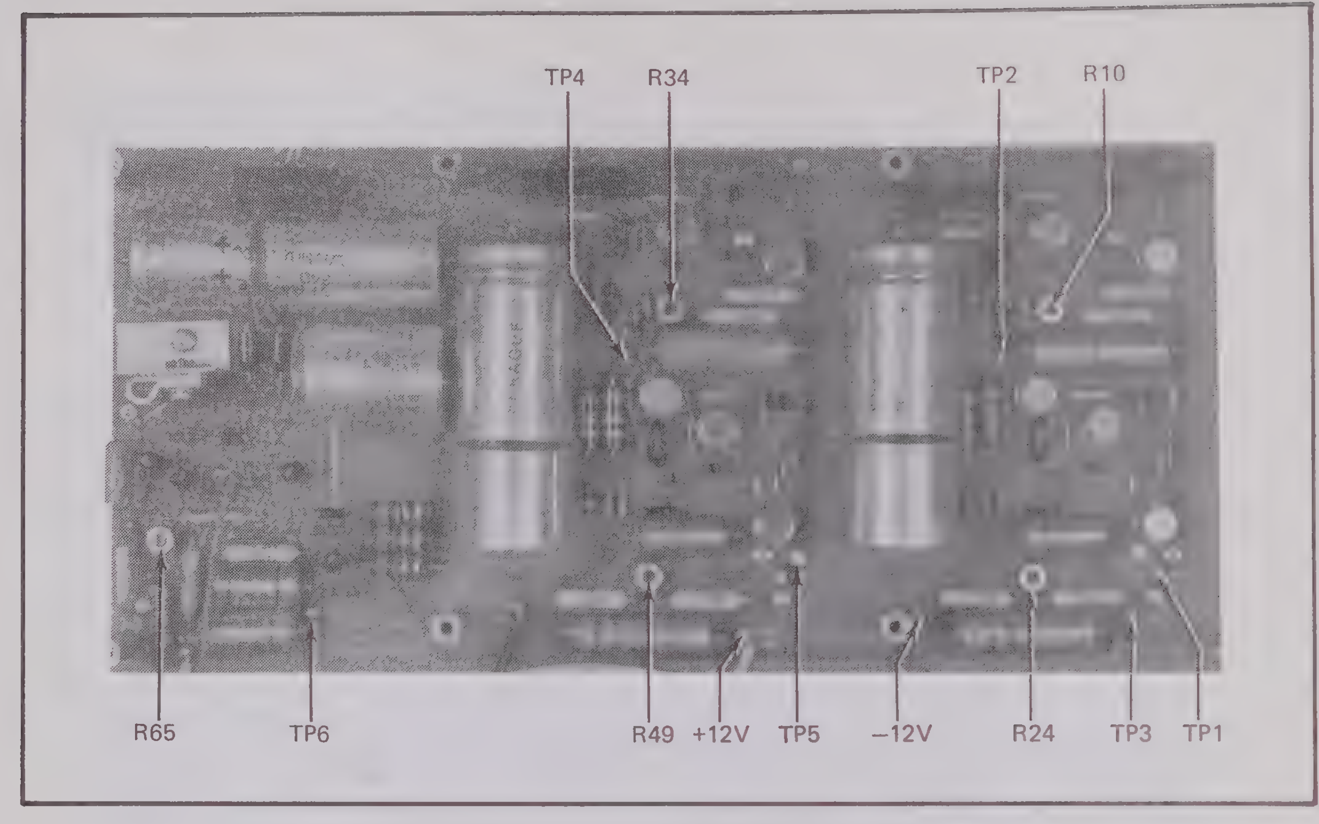


Figure 4-36. ADJUSTMENT AND TEST POINT LOCATIONS (645-4063)

h. Connect the differential voltmeter input to the –12V terminal and its common lead to TP3.

i. Adjust R24 for –12, ±0.01 volts dc at the –12V output terminal.

j. Connect the differential voltmeter input to TP5 and its common lead to TP4.

k. Adjust R34 for +17, ±0.5 volts dc at TP5.

l. Connect the differential voltmeter input to the +12V terminal and its common lead to TP3.

m. Adjust R49 for +12, ±0.01 volts dc at the +12V terminal.

n. Connect the differential voltamter input to TP6 and adjust R65 for +5, ±0.03 volts dc.

o. Disconnect the differential voltmeter from the power supply.

p. Remove ac power from the synthesizer and replace the inner cover of the power supply.

q. Install the power supply assembly in the synthesizer rear panel.

4-92. HARMONIC CHECKS

4-93. Harmonic signals present at the synthesizer variable output must be at least 30 db below the fundamental. To check harmonic output levels, perform the following steps:

a. Connect the input of a spectrum analyzer to the 50 MHz VARIABLE OUTPUT connector. Ensure that this output is terminated into a 50-ohm load.

b. Set the Frequency Dials to 10000000.00 and establish a reference level on the spectrum analyzer display.

c. Tune the spectrum analyzer to the second and then the third harmonic of the selected synthesizer output frequency. Any observed harmonic levels must be at least 30 db below the fundamental output frequency.

d. Repeat steps b and c at synthesizer output frequencies of 20, 30, 40, and 49.9 MHz.

e. Disconnect the spectrum analyzer from the synthesizer.

4-94. TROUBLESHOOTING

4-95. Introduction

4-96. Troubleshooting of the Model 645A can be catagorized into two separate areas: (1) Catastrophic - where no outputs are present, (2) Synthesizing errors - where incorrect output frequencies are obtained. The first malfunction (catastrophic) can usually be attributed to either a power supply problem, if all outputs are equally affected, or an output circuit if only one output is affected. Isolation of a synthesizing error, however, is somewhat more difficult and will require a thorough understanding of the synthesizer circuity. It is therefore recommended that the contents of Section III be thoroughly read and understood before attempting to troubleshoot the synthesizer.

4-97. Isolating a Defective Module

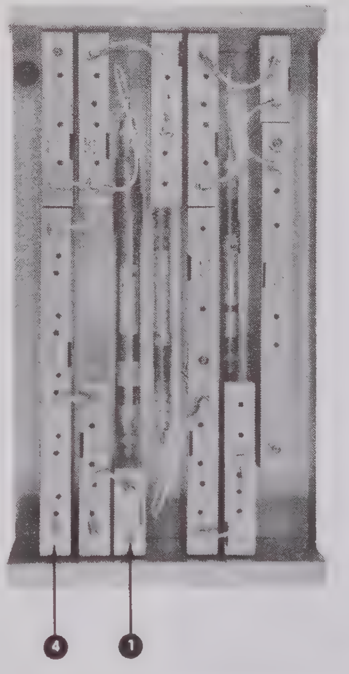
4-98. The best approach in locating a defective module is to first tabulate all known operating discrepancies. This information can then be compared against actual circuit functions to reveal the source of trouble. If the defective module cannot be located by the previous method, the input and output frequencies and signal levels of each module can be measured until the source of trouble is located. If these measurements are accomplished in a logical sequence, whole sections of the synthesizer can be checked with a few measurements. Primary checkpoints and module input-output levels and frequencies are given in Figure 4-37 and Table 4-25. Signal levels are typical values only and may vary several db between instruments. In some cases, these levels are considerably different than those used during actual alignment. Refer to the appropriate alignment paragraphs for the correct alignment levels.

4-99. Locating a Defective Component

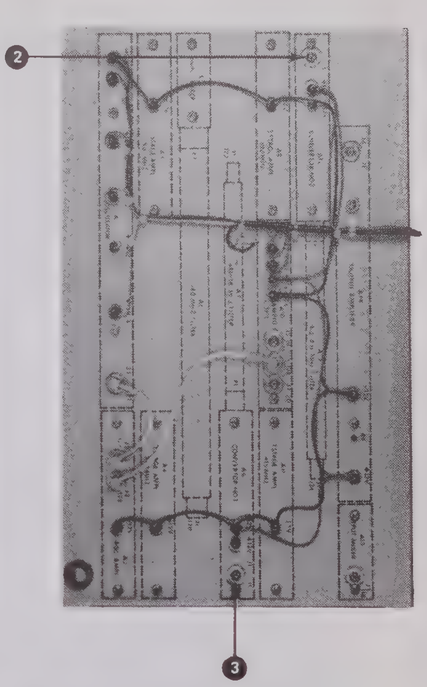
4-100. Once a malfunction has been isolated to a specific module, the assembly can be removed from the synthesizer and tested according to the alignment procedures given in paragraphs 4-39 through 4-91. Again, logically comparing any operating discrepancies against known circuit functions should reveal the source of trouble.

PRIMARY CHECK POINTS	MODULE	SIGNAL LEVEL	FREQUENCY (MHz)	
❶ Cable 5 (A5A5J1)	INPUT MIXER 645-4187	70 — 90 mv		(10 MHz Dial Setting)
			30	4
			40	3
			50	2
			60	1
			70	0
❷ Cable 14 (A5A12J1)	2nd UP CONVERTER 645-4190	90 — 100 mv		(1 MHz Dial Setting)
			30	0
			31	1
			32	2
			33	3
			34	4
			35	5
			36	6
			37	7
			38	8
			39	9
❸ Cable 15 (A5A8J1)	1st UP CONVERTER 645-4189	65 - 75 mv		(.01 thru 100 KHz Dial Setting)
			40.11111	111110.00
			40.22222	222220.00
			40.33333	333330.00
			40.44444	444440.00
			40.55555	555550.00
			40.66666	666660.00
			40.77777	777770.00
			40.88888	888880.00
			40.99999	999990.00
❹ Cable 116 (A5A1J1)	OSCILLATOR 645-4185	35 — 50 mv		(10 MHz Dial Setting)
			370	4
			380	3
			390	2
			400	1
			410	0
SECONDARY CHECK POINT ❺ Cable 108 (A4A32J4)	DIGIT SHIFT 645-4135	100 — 110 mv		(.01 thru 1 kHz Dial Setting)
			4.000000	0000.00
			4.000111	0001.11
			4.000222	0002.22
			4.000333	0003.33
			4.000444	0004.44
			4.000555	0005.55
			4.000666	0006.66
			4.000777	0007.77
			4.000888	0008.88
			4.000999	0009.99

A5 UHF SECTION (TOP VIEW)



A5 UHF SECTION (BOTTOM VIEW)



A4 SUBSYNTHESIZER

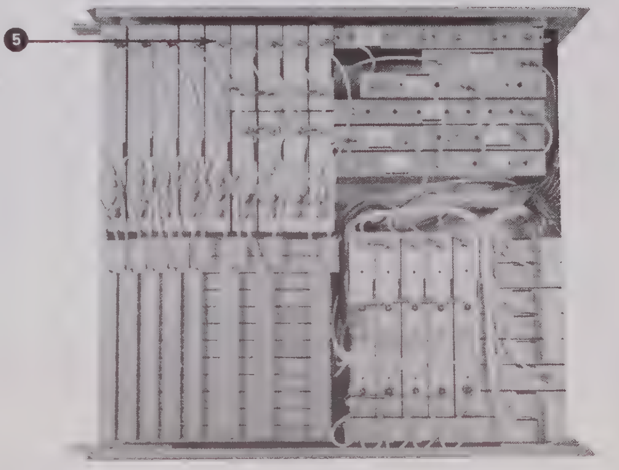


Figure 4-37. PRIMARY CHECK POINTS AND SIGNAL LEVELS

Table 4-25. MODULE INPUT/OUTPUT SIGNALS AND LEVELS (Sheet 1 of 2)

MODULE	CHECK POINT	TYPICAL SIGNAL LEVEL (Into 50 Ohms)	FREQUENCY
645-4101 (A3A7)	Cable (J1)	1V	5
	J6	1V	5
	J3	435 mv	10
645-4102 (A3A8)	Cable 36(J1)	435 mv	10
	J2	1V	10
645-4103 (A3A6)	J3 (10 MHz * of 4)	75 mv	30
645-4104 (A3A5)	J3 (10 MHz * of 3)	85 mv	40
645-4105 (A3A4)	J3 (10 MHz * of 2)	85 mv	50
645-4106 (A3A3)	J3 (10 MHz * of 1)	75 mv	60
645-4107 (A3A2)	J3 (10 MHz * of 0)	80 mv	70
645-4121 (A4A5)	J1 (Input)	135 mv	35
	J3 (Input)	150 mv	4
	J2	70 mv	31
645-4122 (A4A4)	J1 (Input)	135 mv	35
	J3 (Input)	180 mv	3
	J2	90 mv	32
645-4123 (A4A8)	J1 (Input)	190 mv	30
	J3 (Input)	180 mv	3
	J2	95 mv	33
645-4124 (A4 A7)	J1 (Input)	190 mv	30
	J3 (Input)	150 mv	4
	J2	95 mv	34
645-4125 (A4A1)	J1 (Input)	245 mv	40
	J3 (Input)	150 mv	4
	J2	125 mv	36
645-4126 (A4A2)	J1 (Input)	245 mv	40
	J3 (Input)	180 mv	3
	J2	115 mv	37
645-4127 (A4A3)	J1 (Input)	105 mv	35
	J3 (Input)	180 mv	3
	J2	110 mv	38
645-4128 (A4A6)	J1 (Input)	135 mv	35
	J3 (Input)	150 mv	4
	J2	95 mv	39
645-4129-1 (A4A10)	Cable 44(J3)	190 mv	30
	J2	355 mv	30
	J1 (1 MHz * of 0)	120 mv	30
	Cable 43 (J6)	135 mv	35
	J5	320 mv	35
	J4 (1 MHz * of 5)	115 mv	35
645-4129-2 (A4A13)	Cable 50 (J3)	70 mv	31
	J2	290 mv	31
	J1 (1 MHz * of 1)	90 mv	31
	Cable 46 (J6)	125 mv	36
	J5	310 mv	36
	J4 (1 MHz * of 6)	115 mv	36

MODULE	CHECK POINT	TYPICAL SIGNAL LEVEL (Into 50 OHms)	FREQUENCY (MHz)
645-4129-3 (A4A11)	Cable 49 (J3)	90 mv	32
	J2	315 mv	32
	J1 (1 MHz * of 2)	100 mv	32
	Cable 47 (J6)	115 mv	37
	J5	315 mv	37
	J4 (1 MHz * of 7)	115 mv	37
645-4129-4 (A4A14)	Cable 53 (J4)	95 mv	33
	J2 & J3	300 mv	33
	J1 (1 MHz * of 3)	100 mv	33
	Cable 48 (J1)	110 mv	38
	J6	315 mv	38
	J5 (1 MHz * of 8)	105 mv	38
645-4129-5	Cable 52 (J3)	95 mv	34
	J2	325 mv	34
	J1 (1 MHz * of 4)	105 mv	34
	Cable 51 (J6)	95 mv	39
	J5	280 mv	39
	J4 (1 MHz * of 9)	100 mv	39
645-4133 (A4A9)	J6 (1 MHz * of 0-9)	90-100 mv	30 to 39 (1 MHz * of 0-9)
644-4124 (A4A23)	J2	80 mv	2.9—3.1
645-4148 (A4A22)	Cable 99 (J3)	80 mv	2.9—3.1
	Cable 45 (J1)	170 mv	30
	J2	155 mv	32.9—33.1
645-4129-6 (A4A21)	Cable 98 (J4)	155 mv	32.9—33.1
	J3	265 mv	32.9—33.1
	Cable 95 (J2)	120 mv	36.9—37.2
	J1	50 mv	36.9—37.2
645-4134 (A4A9)	Cable 66 (P18)	265 mv	32.9—33.1
	Cable 65 (P17)	300 mv	33
	Cable 84 (P16)	25-50 mv	30—39 (.01 Hz *)
	Cable 92 (P15)	25 mv	33
		65 mv	32.9—33.1 (.01 †)
	Cable 83 (P14)	25—50 mv	30—39 (.1 Hz *)
	Cable 91 (P13)	30 mv	33
		65 mv	32.9—33.1 (.1 †)
	Cable 82 (P12)	25-50 mv	30—39 (1 Hz *)
	Cable 90 (P11)	30 mv	33
		65 mv	32.9—33.1 (1 †)
	Cable 81 (P10)	25-50 mv	30—39 (10 Hz *)
	Cable 89 (P9)	30 mv	33
		65 mv	32.9—33.1 (10 †)
	Cable 80 (P8)	25-50 mv	30—39 (100 Hz *)
	Cable 88 (P7)	30 mv	33
		65 mv	32.9—33.1 (100 †)
	Cable 79 (P6)	25-50 mv	30—39 (1 KHz *)

Table 4-25. MODULE INPUT/OUTPUT SIGNALS AND LEVELS (Sheet 2 of 2)

MODULE	CHECK POINT	TYPICAL SIGNAL LEVEL (Into 50 Ohms)	FREQUENCY (MHz)
645-4134 (Cont)	Cable 87 (P5)	30 mv	33
		65 mv	32.9—33.1 (1 KHz †)
	Cable 78 (P4)	60-80 mv	30—39 (10 KHz *)
	Cable 86 (P3)	50 mv	33
		65 mv	32.9—33.1 (10 KHz †)
	Cable 77 (P2)	60-80 mv	39—39 (100 KHZ *)
	Cable 85 (P1)	50 mv	33
		65 mv	32.9—33.1 (100 KHz †)
645-4135 (A4A33-A-36)	Cable 80-84 (J3)	25-50 mv	30—39 (.01 thru 100 Hz *)
	Cable 54, 110 - 112 (J2)	60 mv	3.99—4.11
	Cable 88 - 92 (J1)	25 mv	33
		65 mv	32.9—33.1
	J4	105 mv	3.99 — 4.11
645-4136	Cable 77-79 (J1)	25-50 mv	30-39 (1 KHz - 100 KHz *)
	J2	125 mv	3—3.9 (1 KHz — 100 KHz *)
645-4137 (A4A26, A30)	Cable 86,87 (J1)	50 mv	33
		65 mv	32.9—33.1 (1 KHZ, 10 KHz, †)
	Cable 104, 108 (J2)	105-110 mv	3.99 — 4.11
	J3	55-65 mv	36.9 — 37.2
645-4138 (A4A24, A28)	Cable 100,105 (J1)	55-65 mv	36.9—37.2
	Cable 101,106 (J2)	125 mv	3 — 3.9
	J2	65 mv	39.9 — 41.1
645-4149 (A4A25, A28)	Cable 102,107 (J1)	65 mv	39.9 — 41.1
	J2	110 mv	3.99 — 4.11
645-4139 (A4A17)	Cable 85 (J2)	50 mv	33
		65 mv	32.9 — 33.1 (100 KHz †)
	Cable 103 (J3)	110 mv	3.99 — 4.11
	J1	120 mv	36.9 — 37.2
645-4141 (A4A18)	Cable 96 (J2)	50 mv	36.9 — 37.2
	Cable 97 (J3)	125 mv	3 — 3.9
	J1	150 mv	39.9 — 41.1
645-4142 (A4A16)	Cable 93 (J2)	150 mv	39.9 — 41.1
	J1	65 mv	39.9 — 41.1
645-4143 (A4A20)	Cable 94 (J1)	65 mv	39.9 — 41.1
	J2	65 — 75 mv	39.9 — 41.1
Oscillator (A5A1)	J1, J2	35—50 mv	370—4 MHz * 380—3 MHz * 390—2 MHz * 400—1 MHz * 410—0 MHz *
645-4186 (A5A3)	Cable 116(J1)	35-50 mv	370—410 **
	J2	460 mv	370—410 **
645-4187 (A5A5)	Cable 119 (J2)	460 mv	370—410 **
	Cable 5 (J1)	70-90 mv	30—70 **
	J3	+7 dbm	340
645-4188 (A5A4)	Cable 120 (J1)	15 mv	340
	J2	455 mv	340
645-4189 (A5A8)	Cable 15 (J1)	65-75 mv	39.9 — 41.1
	Cable 121(J2)	455 mv	340
	J1	+7 dbm	379.9 — 381.1
645-4195 (A5A9)	Cable 122(J1)	35 mv	379.9 — 381.1
	J2	535 mv	379.9 — 381.1
645-4190 (A5A12)	Cable 14 (J1)	90-100 mv	30-39 —1 MHz*
	Cable 123(J2)	535 mv	379.9 — 381.1
	J3	+7 dbm	409.9 — 420.1
645-4196 (A5A11)	Cable 124(J1)	25 mv	409.9 — 420.1
	J2	515 mv	409.9 — 420.1
645-4192 (A5A2)	Cable 117	35-50 mv	370—410 **
	J4	295 mv (1V RMS Output)	370—410 **
645-4191 A5A15)	Cable 125(J2)	515 mv	409.9 — 420.1
	Cable 118(J3)	295 mv (1V RMS Output)	370—410 **
	J1	15 mv	0—50
645-4193	Cable 126(J2)	15 mv	0—50
	J1	1V rms (1V rms Output)	0—50
	J3	0.1V rms (1V RMS Output)	0—0.1

* Frequency Dial Setting

† Search Decade Setting

** Dependent on 10 MHz Dial Settings (See Oscillator A5A1)

SECTION 5

List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section of the manual is a complete illustrated parts list breakdown itemizing all assemblies and their components for this instrument. Illustrations for each listing aid in locating the assemblies and components. A Cross Reference List of Fluke stock numbers to original manufacturers' part numbers is included at the rear of this section.

5-3. Assemblies and subassemblies are identified by a reference designation beginning with the letter A followed by a number (e.g., A1 etc). Electrical components appearing on the schematic diagram are identified by their schematic diagram reference designation. Components not appearing on the schematic diagram are identified by Fluke stock numbers on the illustrations. Flagnotes are sometimes used and refer to special ordering explanations.

5-4. PARTS LIST COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations for the components of the subassembly may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, refer to Appendix B located at the rear of the manual.

c. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

d. The TOT QTY column lists the total quantity of the items used in the instrument and reflects the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF. The TOT QTY column lists the total quantity of the item in that particular assembly.

e. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that a least one of every part in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Number Effectivity List, paragraph 5-9. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part. In this event a parenthetical note is added in the DESCRIPTION column.

5-5. MANUFACTURERS' CROSS REFERENCE LIST COLUMN DESCRIPTIONS

a. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., is listed in the FLUKE STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

b. The Federal Supply Code for the item manufacturer is listed in the MFG column. An abbreviated list of Federal Supply Codes is included in the Appendix.

c. The part number which uniquely identifies the item to the original manufacturer is listed in the MFG PART NO. column. If a component must be ordered by description, the type number is listed.

5-6. HOW TO OBTAIN PARTS

5-7. Standard components have been used wherever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co. factory or authorized representative by using the Fluke part number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-8. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co., if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 215897, Transistor, 2N4126,
A2A1Q1 & Q2 for 645A, S/N 123.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument, is usually most helpful.

5-9. SERIAL NUMBER EFFECTIVITY

5-10. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 645A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

USE CODE	EFFECTIVITY
NONE	Model 645A serial number 123 and on.
A	Model 645A serial number 123 thru 128.
B	Model 645A serial number 129 and on.
C	Model 645A serial number 123 thru 136.
D	Model 645A serial number 137 and on.
E	Model 645A serial number 123 thru 141.
F	Model 645A serial number 142 and on.
G	Model 645A serial number 123 thru 149.
H	Model 645A serial number 150 and on.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	FREQUENCY SYNTHESIZER	645A			
A1	Final Assembly				
A2	Front Panel Assembly (See Figure 5-1)		1		
A3	Input Tray Assembly (See Figure 5-3)	263772	1		
A4	Subsynthesizer Tray Assembly (See Figure 5-10)	263780	1		
A5	UHF Tray Assembly (See Figure 5-28)	263798	1		
A6	Rear Panel Assembly (See Figure 5-37)		1		
	Cover, top	253377	1		
	Cover, bottom	253385	1		
	Foot	230037	1		
	Accessory Kit:	263640	1		
	Rack Mount Kit	256578	1		
	Chassis Slide Kit	261396	1		
	Chassis Slide Spacer	277582	2		
	Basic Accessory Kit	335828	1		
	Line Cord with Plug	226100	1		
	Remote Connector, 132 contacts (pins not included)	275453	1		
	Contact Pins for Remote Connector	275479	132		
	Connector Cover for Remote Connector (includes cable clamps and screws)	275453	1		
	Cable Assembly, BNC/BNC, 4½"	172809	4		
	Accessories Kit	207126	1		
	Cable Assembly, Conhex/Conhex, 18"	205906	1		
	Cable Assembly, Conhex/Conhex, 10"	205823	1		
	Tuning Tool, phenolic, ceramic blade	245225	1		
	Tuning Tool, plastic, metal blade	153049	1		
	Connector Removal Tool	207076	1		
	Adapter, Tee	207118	1		
	Adapter, female	207092	1		
	Adapter, male	207100	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	**FINAL ASSEMBLY**				
	RF Cable No. 1, 23	270033	2		
	RF Cable No. 2	270025	1		
	RF Cable No. 4	270017	1		
	RF Cable No. 6, 9	269985	2		
	RF Cable No. 7	270009	1		
	RF Cable No. 8	270074	1		
	RF Cable No. 14	259622	1		
	RF Cable No. 15	205930	1	1	
	RF Cable No. 17, 19, 20	280842	3		
	RF Cable No. 18	269951	1		
	RF Cable No. 21	269969	1		
	RF Cable No. 22	269977	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**FRONT PANEL ASSEMBLY - Figure 5-1**				
A1	Front Controls PCB Assembly (See Figure 5-2)	265587	1		
DS1	Lamp, incandescent, 28v	277152	1	1	
DS2 thru DS9	Lamp, incandescent, 10v	192120	8	2	
J6	RF Cable No. 3	270058	1		
S1	Switch, pushbutton dpdt, POWER	255836	1		
XDS2 thru XDS9	Socket, lamp	193037	8		
	Access door	259192	1		
	Dial, Digit	260224	10		
	Dial, Decade Selector	265702	1		
	Dial, Digit Interpolator	260232	1		
	Handle	273110	2		
	Knob, Digit, Decade Selector, Digit Interpolator	158949	12		
	Knob, Mode, Sweep Time-Sec, Sweep Width, Frequency Selection	158956	4		
	Knob, ACL Level	162347	1		
	Knob, ACL Level	241018	1		
	Panel, front	252627	1		
	Panel insert, front	252817	1		

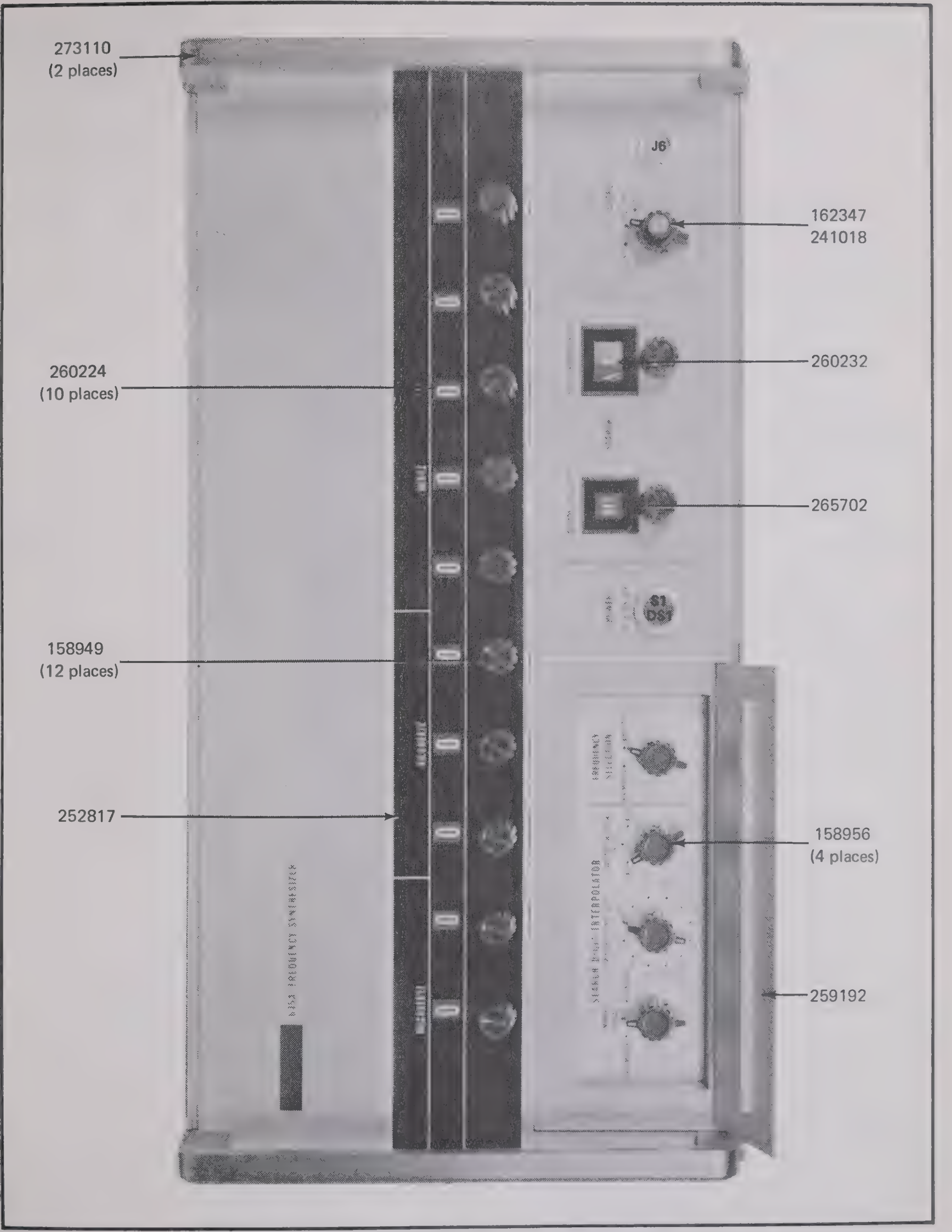

273110
(2 places)
260224
(10 places)
158949
(12 places)
252817
J6
162347
241018
260232
265702
S1
DS1
158956
(4 places)
259192

Figure 5-1. FRONT PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2A1	**FRONT CONTROLS PCB ASSEMBLY - Figure 5-2**	265587	REF		
C2, C3	Cap, Ta, 1 uf ±20%, 35v	161919	2		
C4	Cap, mica, 33 pf ±5%, 500v	160317	1		
C6	Cap, plstc, 0.47 uf ±10%, 200v	271999	1		
C7, C8	Cap, Ta, 78 uf ±5%, 50v	276444	2		
C9 thru C12	Cap, cer, 0.68 uf +80/−20%, 25v	179077	4		
C13, C16	Cap, Ta, 10 uf ±10%, 20v	160259	2		
C15	Cap, Ta, 22 uf ±10%, 15v	182816	1		
C17	Cap, plstc, 0.1 uf ±10%, 250v	161992	1		
CR1 thru CR8, CR10 thru CR19	Diode, germanium, 80 ma, 100 piv	149187	18	1	
CR9	Diode, silicon, 150 ma	203323	1	1	
IC1, IC2	IC, operational amplifier	268961	2	1	G
IC1, IC2	IC, operational amplifier	271502	2	1	H
IC3	IC, operational amplifier	248773	1	1	
J1 thru J5	Connector, coaxial	228866	5		
Q1 thru Q8	Tstr, silicon, PNP	215897	8	2	
R1, R27	Res, comp, 51k ±5%, ¼w	193342	2		
R2, R48	Res, comp, 3.3k ±5%, ¼w	148056	2		
R3	Res, var, ww, 2k ±10%, ¼w	113191	1		
R4	Res, comp, 6.8k ±5%, ¼w	148098	1		
R5	Res, comp, 4.3k ±5%, ¼w	193375	1		
R6	Res, comp, 16k ±5%, ¼w	221606	1		
R7	Res, comp, 33k ±5%, ¼w	148155	1		
R8	Res, comp, 82k ±5%, ¼w	188458	1		
R9	Res, comp, 150k ±5%, ¼w	182212	1		
R10	Res, comp, 330k ±5%, ¼w	192948	1		
R11	Res, comp, 820k ±5%, ¼w	220541	1		
R12	Res, comp, 10M ±5%, ¼w	194944	1		
R14, R16	Res, var, comp, 1k ±30%, ½w	203836	2		
R15	Res, var, ww, 5k ±5%, 3w, DIGIT INTERPOLATOR 1▷	248765	1		
R17, R22	Res, comp, 180k ±5%, ¼w	193441	2		

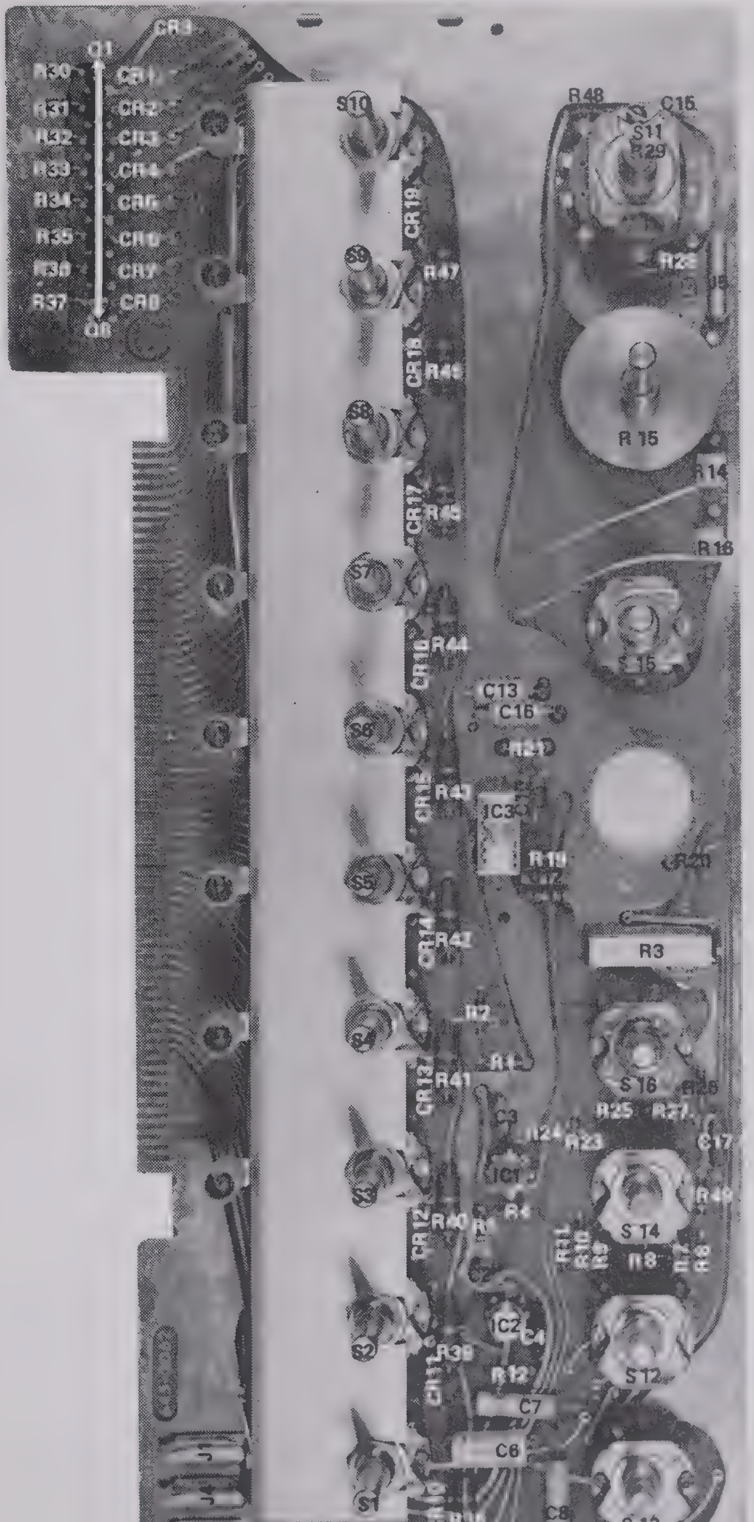

CR9
Q1
R30
R31
R32
R33
R34
R35
R36
R37
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
Q8
S10
R48
C15
S11
R29
CR19
S9
R47
R28
CR18
R46
S8
R15
R14
CR17
R45
R16
S7
S15
R44
CR16
C13
C16
S6
R21
CR15
R43
IC3
R19
R20
S5
CR14
R42
R3
S4
R2
R1
S16
R26
CR13
R41
R25
R27
C3
R24
R23
C17
IC1
S3
R4
S14
R49
CR12
R40
R11
R10
R9
R8
R7
R6
C2
IC2
C4
S2
R39
R12
S12
CR11
C7
C6
J1
J4
S1
CR10
R38
C5
S13
R22
R17
J3
J2

Figure 5-2. FRONT CONTROLS PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R18	Res, comp, 120k ± 5%, ¼w	193458	1		
R19	Res, comp, 27k ±5%, ¼w	148148	1		
R20	Res, comp, 30k ±5%, ¼w	193417	1		
R21	Res, comp, 200k ±5%, ¼w	248781	1		
R23, R30 thru R37	Res, comp, 10k ±5%, ¼w	148106	9		
R24	Res, comp, 1k ±5%, ¼w	148023	1		
R25	Res, comp, 3k ±5%, ¼w	193508	1		
R26	Res, comp, 2k ±5%, ¼w	202879	1		
R28	Res, comp, 220Ω ±5%, ¼w	147959	1		
R29	Res, var, comp, 1k ±30%, ¼w [1]	271528	1		
R38 thru R47	Res, comp, 100Ω ±10%, 1w	109363	10		
R49	Res, comp, 470Ω ±5%, ¼w	147983	1		
S1	Switch, rotary, 10 MHz Digit [1]	267799	1		
S2 thru S5, S15	Switch, rotary, 1 kHz thru 1 MHz Digits, DECADE SELECTOR [1]	248922	5		
S6 thru S10	Switch, rotary, 0.01 Hz thru 100 Hz Digits [1]	272724	5		
S11	Switch, rotary, ACL LEVEL [1]	273201	1		
S12	Switch, rotary, SWEEP TIME SEC [1]	248955	1		
S13	Switch, rotary, MODE [1]	267781	1		
S14	Switch, rotary, SWEEP WIDTH [1]	248963	1		
S16	Switch, rotary, FREQUENCY SELECTION [1]	248971	1		
XIC3	Socket, IC	276527	1		

[1] R15, R29 and S1 thru S16 are not furnished under the Front Controls PCB Assembly, part number 265587. Order each part separately.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	**INPUT TRAY ASSEMBLY - Figure 5-3**	263772	REF		
A1	5 MHz Frequency Standard	283523	1	1	
A2	70 MHz Harmonic Selector Module (645-4107) (See Figure 5-4)	263194	1	1	
A3	60 MHz Harmonic Selector Module (645-4106) (See Figure 5-5)	263186	1	1	
A4	50 MHz Harmonic Selector Module (645-4105) (See Figure 5-5)	263178	1	1	
A5	40 MHz Harmonic Selector Module (645-4104) (See Figure 5-6)	263160	1	1	
A6	30 MHz Harmonic Selector Module (645-4103) (See Figure 5-6)	263152	1	1	
A7	5 MHz Filter Amplifier Module (645-4101) (See Figure 5-7)	263137	1	1	
A8	Spectrum Generator Module (645-4102) (See Figure 5-8)	263145	1	1	
A9	40 MHz 10/1 Divider Module (645-4109) (See Figure 5-9)	263210	1	1	
A10	30 MHz 10/1 Divider Module (645-4108) (See Figure 5-9)	263202	1	1	
A11	Bus, Block Assembly (645-4240)	274548	1		
C1, C2	Cap, cer, 0.05 uf ±20%, 100v (mounted on XA1)	149161	2		
TB5	Terminal board	253427	1		
XA1	Socket, 5 MHz Frequency Standard	274852	1		
	RF Cable No. 34, 35, 36	205773	3		

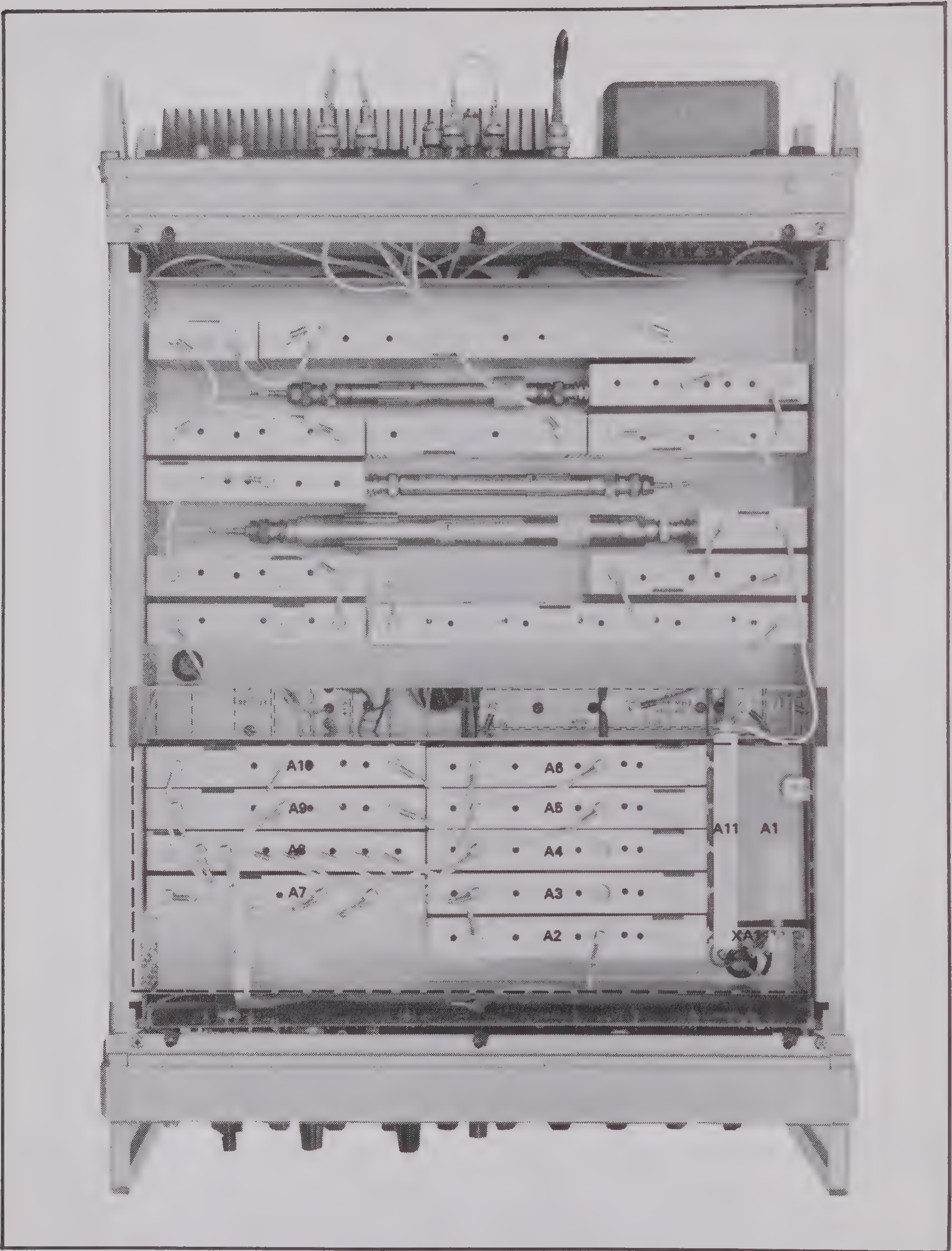

A10
A6
A9
A5
A11
A1
A8
A4
A7
A3
A2
XA1

Figure 5-3. INPUT TRAY ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A2	**70 MHz HARMONIC SELECTOR MODULE (645-4107)** **Figure 5-4**	263194	REF		
A1	70 MHz Harmonic Selector PCB Assembly (See Figure 5-4)	264168	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	4		
	Frame, enclosure	253112	1		
	Cover, enclosure	269506	2		
	70 MHz HARMONIC SELECTOR PCB ASSEMBLY Figure 5-4	264168	REF		
C1	Cap, mica, 8 pf ±10%, 500v	216986	1		
C2, C6, C8, C10 thru C13, C17, C18, C20, C26, C30, C31	Cap, cer, 0.0012 uf ±10%, 500v	106732	13		
C3, C14	Cap, mica, 43 pf ±1%, 500v	277202	2		
C4, C5, C19	Cap, cer, 0.05 uf ±20%, 100v	149161	3		
C7, C29	Cap, mica, 47 pf ±5%, 500v	148536	2		
C9, C27	Cap, mica, 2 pf ±0.5 pf, 500v	175208	2		
C15, C16, C28	Cap, mica, 4 pf ±5%, 500v	190397	3		
C21, C22	Cap, mica, 560 pf ±5%, 500v	170431	2		
C23, C24	Cap, mica, 430 pf ±5%, 500v	177980	2		
C25	Cap, mica, 68 pf ±5%, 500v	148510	1		
CR1, CR2, CR3	Diode, germanium, 80 ma, 100 piv	149187	3		
IC1	IC, differential/cascode amplifier	246256	1		
IC2	IC, J-K Flip flop	267278	1		
L1, L2, L4 thru L7	Ferrite bead	219535	6		
L3, L8, L9, L11	Inductor, RF, 3 turns, 50 MHz	269043	4		
L10	Inductor, RF, 4 turns, 25 MHz	255497	1		

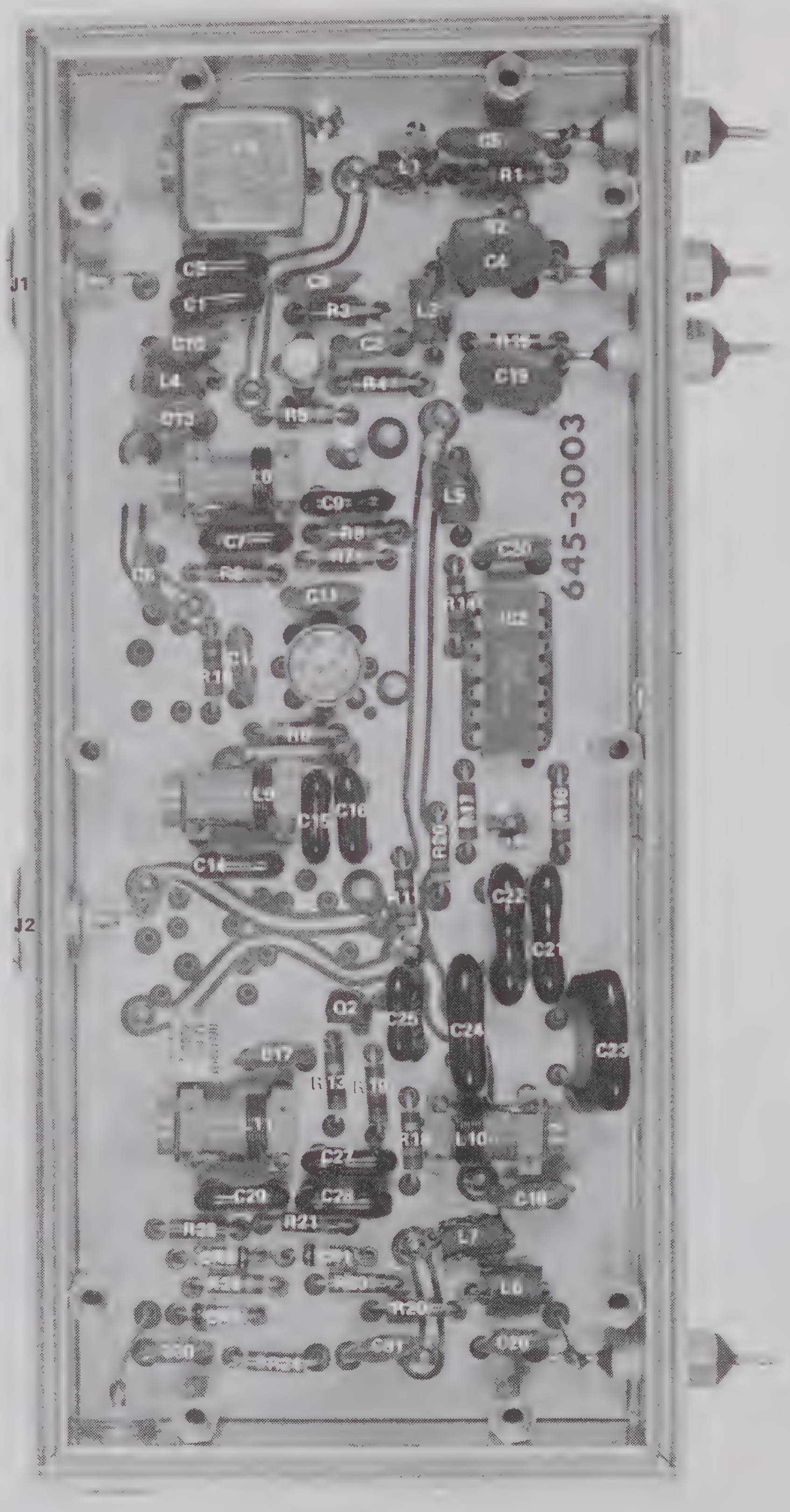

J1
J2
645-3003
C5
L1
R1
R2
C4
C3
C1
R3
L2
C2
L4
R4
C19
R5
L5
C9
R8
C7
R7
C11
R14
U2
R17
R16
L9
C15
C16
C14
C22
C21
Q2
C25
C24
C23
C17
R13
R19
L11
L10
C27
C20
C28
R21
L7
L6

Figure 5-4. 70 MHz HARMONIC SELECTOR MODULE (645-4107)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q1	Tstr, Mos-FET, N-channel	267765	1		
Q2	Tstr, silicon, NPN	248351	1		
R1, R2, R15	Res, comp, 47Ω ±5%, ¼w	147892	3		
R3, R4, R8, R11	Res, comp, 3.3k ±5%, ¼w	148056	4		
R5, R25	Res, comp, 10k ±5%, ¼w	148106	2		
R6, R7, R10, R19	Res, comp, 100Ω ±5%, ¼w	147926	4		
R9, R26	Res, comp, 6.8k ±5%, ¼w	148098	2		
R12	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R13	Res, comp, 10Ω ±5%, ¼w	147868	1		
R14, R18	Res, comp, 1.8k ±5%, ¼w	175042	2		
R16, R17	Res, comp, 5.6Ω ±5%, ¼w	208033	2		
R20	Res, comp, 620Ω ±5%, ¼w	221903	1		
R21	Res, comp, 2.2k ±5%, ¼w	148049	1		
R22	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 560Ω ±5%, ¼w	147991	1		
R24	Res, comp, 1.5k ±5%, ¼w	148031	1		
	Enclosure, L3	274811	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A3	**60 MHz HARMONIC SELECTOR MODULE (645-4106)** **Figure 5-5**	263186	REF		
A1	60 MHz Harmonic Selector PCB Assembly (See Figure 5-5)	264150	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	253112	1		
	Cover, enclosure	269506	2		
	Plug, threaded	207084	1		
	60 MHz HARMONIC SELECTOR PCB ASSEMBLY Figure 5-5	264150	REF		
C1	Cap, mica, 8 pf ±10%, 500v	216986	1		
C2, C6, C8, C10 thru C13, C15, C17, C18, C30, C31	Cap, cer, 0.0012 uf ±10%, 500v	106732	12		
C3	Cap, mica, 62 pf ±5%, 500v	276469	1		
C4, C5	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C7, C14, C29	Cap, cer, 68 pf ±1%, 500v	266593	3		
C9	Cap, mica, 4 pf ±5%, 500v	190397	1		
C16, C28	Cap, mica, 5 pf ±10%, 500v	148577	2		
C27	Cap, mica, 2 pf ±0.5 pf, 500v	175208	1		
CR1 thru CR3	Diode, germanium, 80 ma, 100 piv	149187	3		
IC1	IC, differential/cascode amplifier	246256	1		
L1, L2, L4, L6, L7	Ferrite bead	219535	5		
L3, L8, L9, L11	Inductor, RF, 3 turns, 50 MHz	269043	4		
Q1	Tstr, Mos-FET, N-channel	267765	1		
Q2	Tstr, silicon, NPN	248351	1		
R1, R2	Res, comp, 47Ω ±5%, ¼w	147892	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R3, R4, R8, R11	Res, comp, 3.3k ±5%, ¼w	148056	4		
R5, R25	Res, comp, 10k ±5%, ¼w	148106	2		
R6, R7, R10, R19	Res, comp, 100Ω ±5%, ¼w	147926	4		
R9	Res, comp, 6.8k ±5%, ¼w	148098	1		
R12	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R13	Res, comp, 10Ω ±5%, ¼w	147868	1		
R18	Res, comp, 1.8k ±5%, ¼w	175042	1		
R20	Res, comp, 620Ω ±5%, ¼w	221903	1		
R21	Res, comp, 2.2k ±5%, ¼w	148049	1		
R22	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 560Ω ±5%, ¼w	147991	1		
R24	Res, comp, 1.5k ±5%, ¼w	148031	1		
	Enclosure, L3	274811	1		

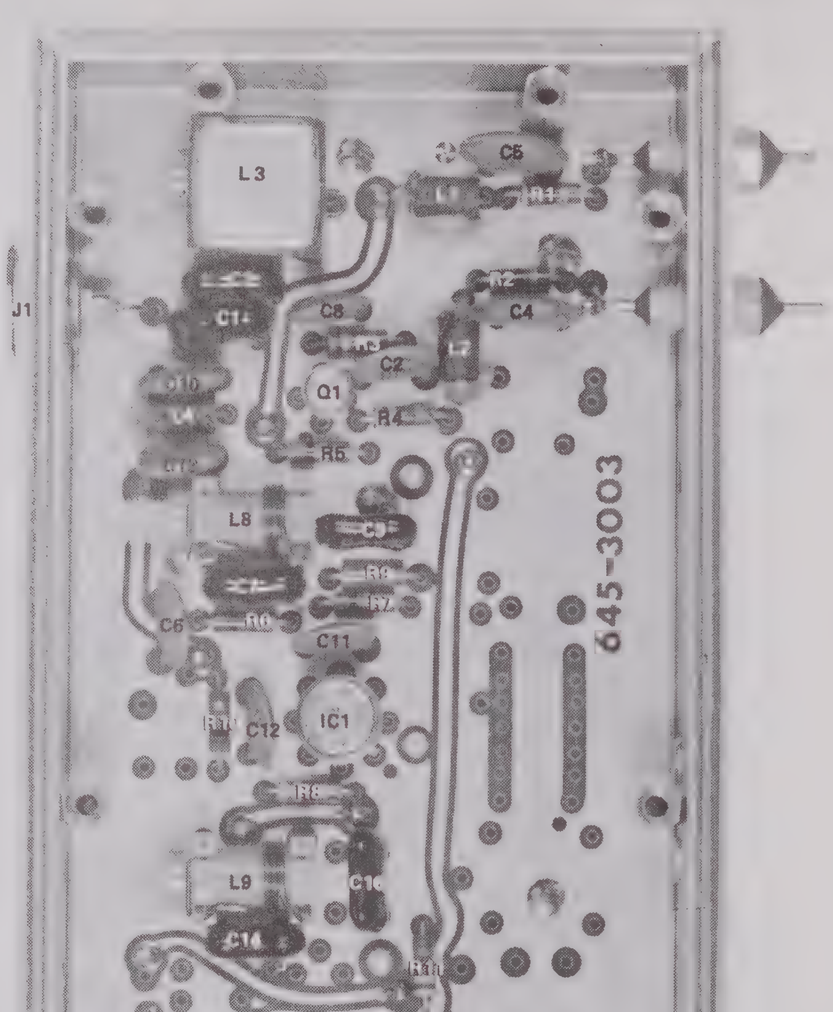

L3
C5
R1
J1
C1+
C8
R2
C4
R3
C2
Q1
C10
R4
R5
L8
C9
R9
R7
C6
R6
C11
645-3003
R10
C12
IC1
R8
L9
C16
C14
R11
Q2
R12
C17
R19
L11
R18
C27
C18
C29
R22
R21
L7
CR2
CR1
R23
CR3
R20
C30
R24
C31
C15
J2

Figure 5-5. 60 MHz HARMONIC SELECTOR MODULE (645-4106), 50 MHz HARMONIC SELECTOR MODULE (645-4105)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A4	**50 MHz HARMONIC SELECTOR MODULE (645-4105)** **Figure 5-5**	263178	REF		
A1	50 MHz Harmonic Selector PCB Assembly (See Figure 5-5)	264143	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	253112	1		
	Cover, enclosure	269506	2		
	Plug, threaded	207084	1		
	50 MHz HARMONIC SELECTOR PCB ASSEMBLY Figure 5-5	264143	REF		
C1, C16, C28	Cap, mica, 10 pf ±10%, 500v	175216	3		
C2, C6, C8, C10 thru C13, C15, C17, C18, C30, C31	Cap, cer, 0.0012 uf ±10%, 500v	106732	12		
C3,C7,C14, C29	Cap, mica, 100 pf ±1%, 500v	226126	4		
C4, C5	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C9	Cap, mica, 5 pf ±10%, 500v	148577	1		
C27	Cap, mica, 2 pf ±0.5 pf, 500v	175208	1		
CR1 thru CR3	Diode, germanium, 80 ma, 100 piv	149187	3		
IC1	IC, differential/cascode amplifier	246256	1		
L1, L2, L4 L6, L7	Ferrite bead	219535	5		
L3, L8, L9, L11	Inductor, RF, 3 turns, 50 MHz	269043	4		
Q1	Tstr, Mos-FET, N-channel	267765	1		
Q2	Tstr, silicon, NPN	248351	1		
R1, R2	Res, comp, 47Ω ±5%, ¼w	147892	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R3, R4, R8 R11	Res, comp, 3.3k ±5%, ¼w	148056	4		
R5, R25	Res, comp, 10k ±5%, ¼w	148106	2		
R6, R7, R10, R19	Res, comp, 100Ω ±5%, ¼w	147926	4		
R9	Res, comp, 6.8k ±5%, ¼w	148098	1		
R12	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R13	Res, comp, 10Ω ±5%, ¼w	147868	1		
R18	Res, comp, 1.8k ±5%, ¼w	175042	1		
R20	Res, comp, 620Ω ±5%, ¼w	221903	1		
R21	Res, comp, 2.2k ±5%, ¼w	148049	1		
R22	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 560Ω ±5%, ¼w	147991	1		
R24	Res, comp, 1.5k ±5%, ¼w	148031	1		
	Enclosure, L3	274811	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A5	**40 MHz HARMONIC SELECTOR MODULE (645-4104) Figure 5-6**	263160	REF		
A1	40 MHz Harmonic Selector PCB Assembly (See Figure 5-6)	264135	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	253112	1		
	Cover, enclsoure	269506	2		
	40 MHz HARMONIC SELECTOR PCB ASSEMBLY Figure 5-6	264135	REF		
C1	Cap, mica, 12 pf ±5%, 500v	175224	1		
C2, C6, C8, C10 thru C13, C17 thru C21, C25, C30 C31	Cap, cer, 0.0012 uf ±10%, 500v	106732	15		
C3, C7, C14, C29	Cap, mica, 100 pf ±1%, 500v	226126	4		
C4, C5	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C9	Cap, mica, 4 pf ±5%, 500v	190397	1		
C15	Cap, mica, 5 pf ±10%, 500v	148577	1		
C16	Cap, mica, 15 pf ±5%, 500v	148569	1		
C27	Cap, mica, 2 pf ±0.5 pf, 500v	175208	1		
C28	Cap, mica, 8 pf ±10%, 500v	216986	1		
CR1 thru CR3	Diode, germanium, 80 ma, 100 piv	149187	3		
IC1	IC, differential/cascode amplifier	246256	1		
L1, L2, L4, L6, L7	Ferrite bead	219535	5		
L3, L8, L9, L11	Inductor, RF, 4 turns, 25 MHz	255497	4		
Q1	Tstr, Mos-FET, N-channel	267765	1		
Q2, Q3	Tstr, silicon, NPN	248351	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R1, R2	Res, comp, 47Ω ±5%, ¼w	147892	2		
R3, R4, R8, R11	Res, comp, 3.3k ±5%, ¼w	148056	4		
R5, R25	Res, comp, 10k ±5%, ¼w	148106	2		
R6, R7, R10, R19, R26	Res, comp, 100Ω ±5%, ¼w	147926	5		
R9	Res, comp, 6.8k ±5%, ¼w	148098	1		
R12	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R13	Res, comp, 10Ω ±5%, ¼w	147868	1		
R14	Res, comp, 1k ±5%, ¼w	148023	1		
R15	Res, comp, 51Ω ±5%, ¼w	221879	1		
R16	Res, comp, 22Ω ±5%, ¼w	147884	1		
R17	Res, comp, 2.7k ±5%, ¼w	170720	1		
R18	Res, comp, 1.8k ±5%, ¼w	175042	1		
R20	Res, comp, 620Ω ±5%, ¼w	221903	1		
R21	Res, comp, 2.2k ±5%, ¼w	148049	1		
R22	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 560Ω ±5%, ¼w	147991	1		
R24	Res, comp, 1.5k ±5%, ¼w	148031	1		
	Enclosure, L3	274811	1		

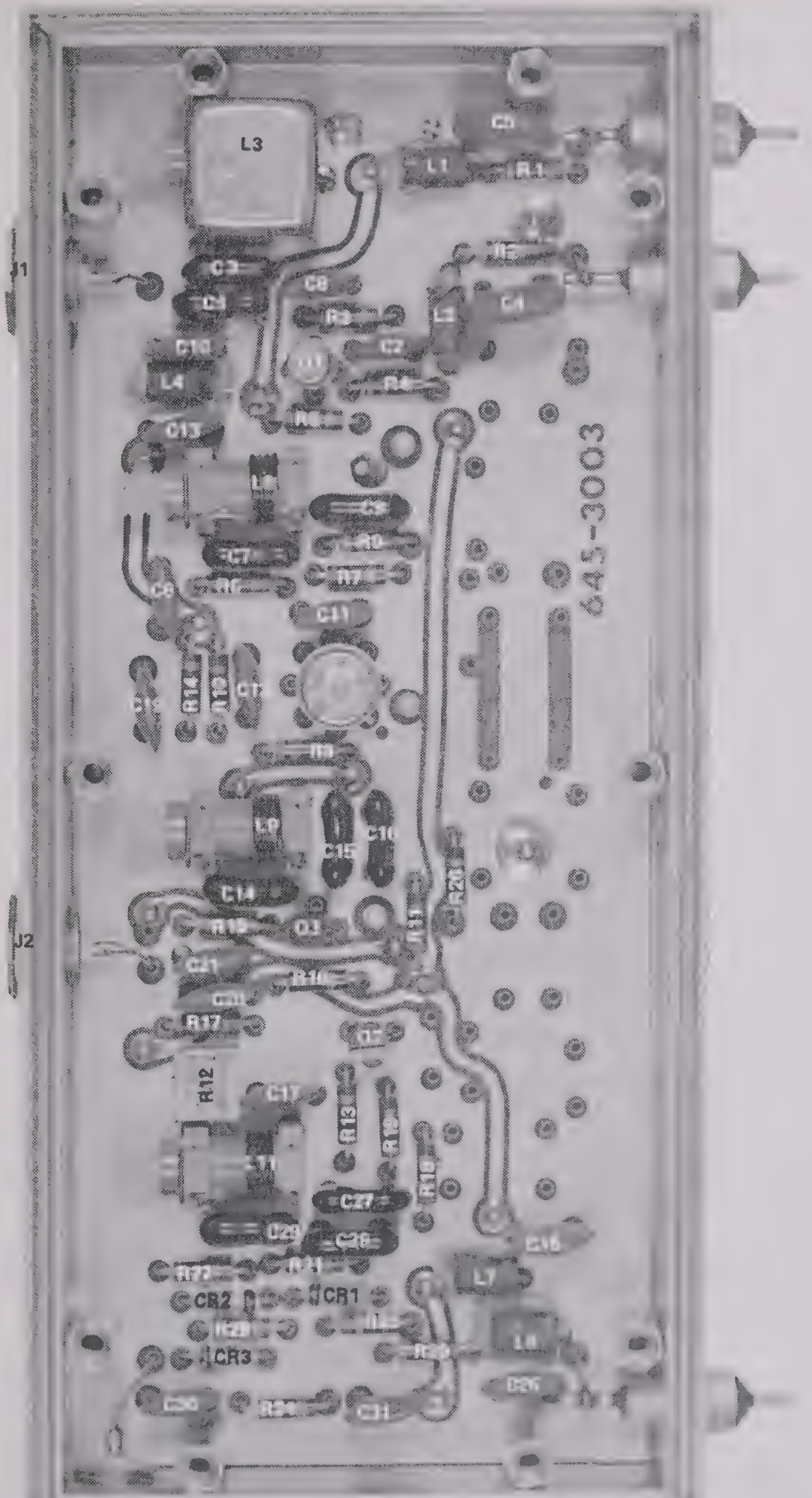

L3
C9
L1
R1
R2
J1
C3
C5
C8
C4
L2
R3
C10
C2
L4
R4
R5
C13
R9
C7
R7
C6
C11
645-3003
R14
R15
C12
R8
L9
C16
C15
R20
C14
R19
J2
R11
C21
R16
C20
R17
C7
R12
C17
R13
R18
R10
C27
C29
C28
C16
R22
R21
L7
CR2
CR1
R28
L8
CR3
C26
C30
R24
C31
J3

Figure 5-6. 40 MHz HARMONIC SELECTOR MODULE (645-4104), 30 MHz HARMONIC SELECTOR MODULE (645-4103)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A6	**30 MHz HARMONIC SELECTOR MODULE (645-4103) - Figure 5-6**	263152	REF		
A1	30 MHz Harmonic Selector PCB Assembly (See Figure 5-6)	264127	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	253112	1		
	Cover, enclosure	269506	2		
	30 MHz HARMONIC SELECTOR PCB ASSEMBLY Figure 5-6	264127	REF		
C1	Cap, mica, 15 pf ±5%, 500v	148569	1		
C2, C6, C8, C10 Thru C13, C17 thru C21, C25, C30, C31	Cap, mica, 0.0012 uf ±10%, 500v	106732	15		
C3	Cap, mica, 190 pf ±1%, 500v	284778	1		
C4, C5	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C7, C29	Cap, mica, 200 pf ±1%, 500v	284794	2		
C9, C15	Cap, mica, 10 pf ±10%, 500v	175216	2		
C14	Cap, mica, 180 pf ±1%, 500v	284786	1		
C16, C28	Cap, mica, 18 pf ±5%, 500v	266585	2		
C27	Cap, mica, 5 pf ±10%, 500v	148577	1		
CR1 thru CR3	Diode, germanium, 80 ma, 100 piv	149187	3		
IC1	IC, differential/cascode amplifier	246256	1		
L1, L2, L4, L6, L7	Ferrite bead	219535	5		
L3, L8, L9, L11	Inductor, RF, 4 turns, 25 MHz	255497	4		
Q1	Tstr, Mos-FET, N-channel	267765	1		
Q2, Q3	Tstr, silicon, NPN	248351	2		
R1, R2	Res, comp, 47Ω ±5%, ¼w	147892	2		
R3, R4, R8, R11	Res, comp, 3.3k ±5%, ¼w	148056	4		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5, R25	Res, comp, 10k ±5%, ¼w	148106	2		
R6, R7, R10, R19, R26	Res, comp, 100Ω ±5%, ¼w	147926	5		
R9	Res, comp, 6.8k ±5%, ¼w	148098	1		
R12	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R13	Res, comp, 10Ω ±5%, ¼w	147868	1		
R14	Res, comp, 1k ±5%, ¼w	148023	1		
R15	Res, comp, 51Ω ±5%, ¼w	221879	1		
R16	Res, comp, 22Ω ±5%, ¼w	147884	1		
R17	Res, comp, 2.7k ±5%, ¼w	170720	1		
R18	Res, comp, 1.8k ±5%, ¼w	175042	1		
R20	Res, comp, 620Ω ±5%, ¼w	221903	1		
R21	Res, comp, 2.2k ±5%, ¼w	148049	1		
R22	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 560Ω ±5%, ¼w	147991	1		
R24	Res, comp, 1.5k ±5%, ¼w	148031	1		
	Enclosure, L3	274811	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A7	**5 MHz FILTER AMPLIFIER MODULE (645-4101)** **Figure 5-7**	263137	REF		
A1	5 MHz Filter Amplifier PCB Assembly (See Figure 5-7)	264101	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	269555	1		
	Cover, enclosure	269506	2		
	5 MHz FILTER AMPLIFIER PCB ASSEMBLY - Figure 5-7	264101	REF		
C1	Cap, cer, 0.01 uf ±20%, 100v	149153	1		
C2, C3, C6, C7, C8, C11 C13, C16, C18, C21, C22, C25,	Cap, cer, 0.05 uf ±20%, 100v	149161	12		
C4	Cap, mica, 510 pf ±5%, 500v	148411	1		
C5	Cap, mica, 150 pf ±5%, 500v	148478	1		
C9, C15	Cap, var, 7-25 pf, 350v	229948	2		I
C10, C14	Cap, mica, 220 pf ±5%, 500v	170423	2		
C12, C17	Cap, mica, 560 pf ±5%, 500v	170431	2		
C19	Cap, mica, 430 pf ±5%, 500v	177980	1		
C20	Cap, mica, 1800 pf ±5%, 500v	148353	1		
C23	Cap, mica, 1500 pf ±5%, 500v	148361	1		
C24	Cap, mica, 390 pf ±5%, 500v	148437	1		
CR1	Diode, silicon, 150 ma	203323	1		
L1, L3	Inductor, 1000 uh, 140 ma	147819	2		
L2	Inductor, var, nom, 6 uh	172940	1		
L4	Inductor, var, nom, 0.635 uh	173112	1		
L5	Inductor, 1 uh, 2300 ma	207589	1		
Q1, Q2	Tstr, silicon, NPN	246264	2		
Q3 thru Q6	Tstr, silicon, NPN	179374	4		
R1, R6	Res, comp, 51Ω ±5%, ¼w	221879	2		

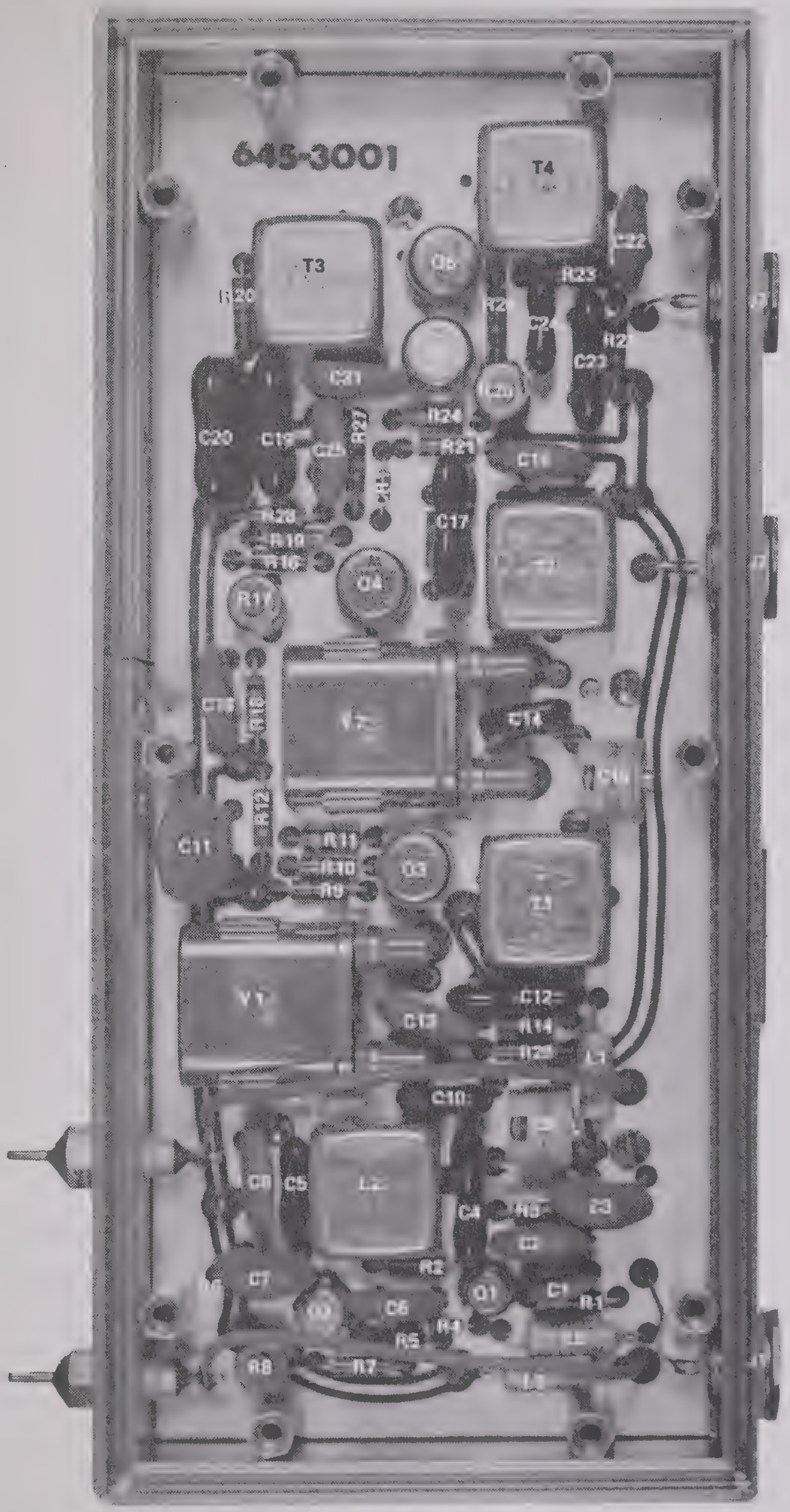

645-3001
T4
T3
C22
Q5
R23
R20
C24
C23
C21
R24
R27
C20
C19
C25
R21
C16
R18
R16
C17
R17
Q4
Y2
C14
R12
C11
R11
R10
Q3
R9
Y1
C12
C13
R14
L1
C10
C8
C5
L2
C4
R3
R2
C7
Q1
C1
R1
C6
R4
R5
R8
R7

Figure 5-7. 5 MHz FILTER AMPLIFIER MODULE (645-4101)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2, R14, R23	Res, comp, 8.2k ±5%, ¼w	160796	3		
R3, R13, R22, R24, R26, R27, R29	Res, comp, 100Ω ±5%, ¼w	147926	7		
R4	Res, comp, 270Ω ±10%, 1/8w	261834	1		
R5	Res, comp, 270Ω ±5%, ¼w	160804	1		
R7	Res, comp, 3.3k ±5%, ¼w	148056	1		
R8	Res, var, cer met, 5k ±20%, ½w	226084	1		
R9,R15	Res, comp, 5.6k ±5%, ¼w	148080	2		J
R9	Res, comp, 5.6k ±5%, ¼w	148080	REF		K
R10	Res, comp, 180Ω ±5%, ¼w	147942	1		
R11	Res, comp, 33Ω ±5%, ¼w	175034	1		
R12	Res, comp, 1k ±5%, ¼w	148023	1		
R15	Res, comp, 15k ± 5%, ¼w	148114	1		J
R16	Res, comp, 56Ω ±5%, ¼w	147900	1		
R17	Res, var, cer met, 100Ω ±20%, ½w	193052	1		
R18	Res, comp, 330Ω ±5%, ¼w	147967	1		
R19, R28	Res, comp, 4.7k ±5%, ¼w	148072	2		
R20	Res, comp, 12k ±5%, ¼w	159731	1		
R21	Res, comp, 22k ±5%, ¼w	148130	1		
R25	Res, var, cer met, 200Ω ±20%, ½w	226050	1		
T1, T2	Transformer, var, nom, 2.5 uh	254201	2		
T3	Transformer, var, nom, 5.8 uh	273680	1		
Y1, Y2	Crystal, 5 MHz	255927	2		
	Socket, crystal	148668	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A8	**SPECTRUM GENERATOR MODULE (645-4102)** **Figure 5-8**	263145	REF		
A1	Spectrum Generator PCB Assembly (See Figure 5-8)	264119	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	269548	1		
	Cover, enclosure	269522	2		
	RF Cable No. 29 & 30	270181	2		
	RF Cable No. 31	270215	1		
	RF Cable No. 32	270207	1		
	RF Cable No. 33	270231	1		
	SPECTRUM GENERATOR PCB ASSEMBLY - Figure 5-8	264119	REF		
C1 thru C4, C6, C8, C9, C11	Cap, cer, 0.05 uf ±20%, 100v	149161	8		
C5, C7, C22	Cap, mica, 390 pf ±5%, 500v	148437	3		
C12	Cap, cer, 22 pf ±5%, 500v	275529	1		
C13	Cap, cer, 0.0012 uf ±10%, 500v	106732	1		
C14	Cap, cer, 33 pf ±5%, 500v	275537	1		
C15, C16	Cap, cer, 68 pf ±5%, 500v	275545	2		
C17	Cap, mica, 82 pf ±1%, 500v	271957	1		
C18	Cap, mica, 270 pf ±5%, 500v	148452	1		
C19	Cap, mica, 110 pf ±1%, 500v	170415	1		
C20, C25	Cap, mica, 330 pf ±5%, 500v	148445	2		
C21,C23	Cap, mica, 180 pf ±1%, 500v	284786	2		
C24	Cap, mica, 470 pf ±5%, 500v	148429	1		
C26	Cap, mica, 750 pf ±5%, 500v	208983	1		
CR1	Diode, step recovery, silicon	248294	1		
L1, L2	Inductor, 1000 uh, 140 ma	147819	2		

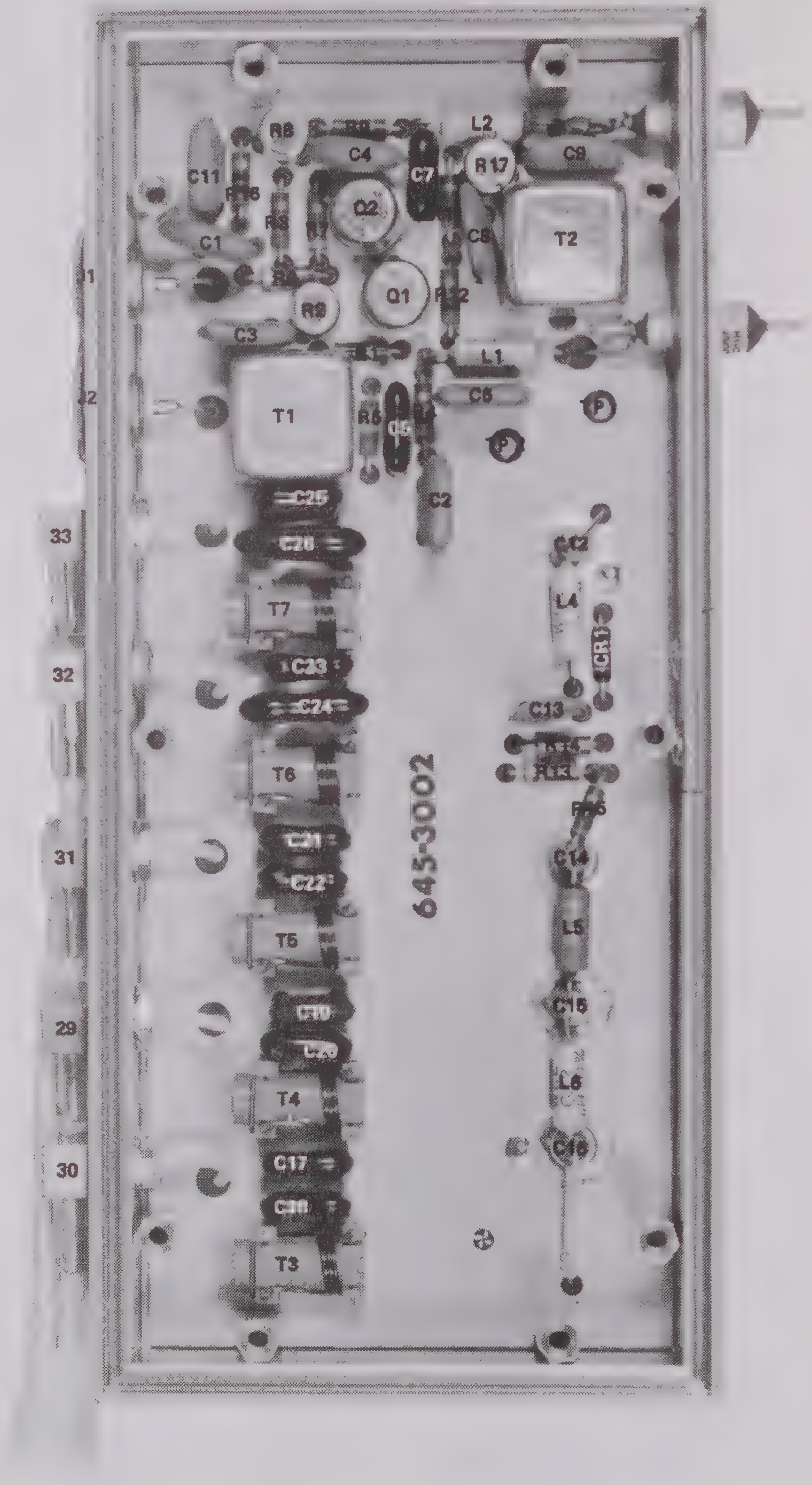

R8
R9
L2
C4
C9
R17
C11
R16
C7
Q2
R3
R7
C1
C8
T2
J1
R2
Q1
R12
C3
L1
J2
T1
R5
C6
TP
TP
C2
C25
33
C26
C12
L4
T7
CR1
32
C23
C24
C13
R14
R13
T6
645-3002
R15
31
C21
C14
C22
L5
T5
29
C19
C15
C20
T4
L6
30
C17
C16
C18
T3

Figure 5-8. SPECTRUM GENERATOR MODULE (645-4102)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
L4	Inductor, 1 uh, 2300 ma	207589	1		
L5	Inductor, 0.12 uh, 2860 ma	272617	1		
L6	Inductor, 0.12 uh	256289	1		
Q1, Q2	Tstr, silicon, NPN	179374	2		
R1, R16	Res, comp, 10Ω ±5%, ¼w	147868	2		
R2, R8	Res, var, cer met, 100Ω ±20%, ½w	193052	2		
R3, R9	Res, comp, 180Ω ±5%, ¼w	147942	2		
R4, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R5	Res, comp, 12k ±5%, ¼w	159731	1		
R6, R7	Res, comp, 4.7k ±5%, ¼w	148072	2		
R10	Res, comp, 27Ω ±5%, ¼w	160812	1		
R11	Res, comp, 8.2k ±5%, ¼w	160796	1		
R13	Res, comp, 330Ω ±5%, ¼w	147967	1		
R14, R15	Res, comp, 82Ω ±5%, ¼w	149484	2		
R17	Res, var, cer met, 200Ω ±20%, ½w	226050	1		
T1, T2	Transformer, var, nom, 0.45 uh	254219	2		
T3, T4, T5	Transformer, RF	255521	3		
T6, T7	Transformer, RF	255513	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A9	**40 MHz 10/1 DIVIDER MODULE (645-4109) - Figure 5-9**	263210	REF		
A1	40 MHz 10/1 Divider PCB Assembly (See Figure 5-9)	264184	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	269530	1		
	Cover, enclosure	269514	2		
	40 MHz 10/1 DIVIDER PCB ASSEMBLY - Figure 5-9	264184	REF		
C1, C2, C4 C5, C7, C9, C12, C14, C16, C18, C19	Cap, cer, 0.0012 uf ±10%, 500v	106732	11		
C3, C13	Cap, mica, 100 pf ±1%, 500v	226126	2		
C6	Cap, mica, 8 pf ±10%, 500v	216986	1		
C8	Cap, mica, 110 pf ±1%, 500v	170415	1		
C10	Cap, mica, 12 pf ±5%, 500v	175224	1		
C11	Cap, mica, 4 pf ±5%, 500v	190397	1		
C15	Cap, mica, 33 pf ±5%, 500v	160317	1		
C17	Cap, cer, 0.05 uf ±20%, 100v	149161	1		
C20	Cap, mica, 22 pf ±5%, 500v	148551	1		
C21	Cap, mica, 180 pf ±5%, 500v	148460	1		
C22	Cap, mica, 560 pf ±5%, 500v	170431	1		
IC1	IC, differential/cascode amplifier	246256	1		
IC2, IC3	IC, TTL, Dual J-K Flip Flop	267260	2		
L1, L3, L5, L8	Ferrite bead	219535	4		
L2, L4, L6	Inductor, RF, 4 turns, 25 MHz	255497	3		
L7	Inductor, 10 uh, 432 ma	249078	1		
L9	Inductor, 22 uh, 590 ma	147843	1		
Q1, Q2	Tstr, silicon, NPN	248351	2		
R1, R6	Res, comp, 56Ω ±5%, ¼w	147900	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2	Res, comp, 27Ω ±5%, ¼w	160812	1		
R3, R9	Res, comp, 3.3k ±5%, ¼w	148056	2		
R4, R10, R14	Res, comp, 4.7k ±5%, ¼w	148072	3		
R5, R11, R13	Res, comp, 470Ω ±5%, ¼w	147983	3		
R7	Res, comp, 47Ω ±5%, ¼w	147892	1		
R8	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R12	Res, comp, 1k ±5%, ¼w	148023	1		
R15	Res, comp, 2.7k ±5%, ¼w	170720	1		
R16	Res, comp, 270Ω ±5%, ¼w	160804	1		
R17	Res, comp, 680Ω ±5%, ¼w	148007	1		
R18	Res, comp, 10Ω ±5%, ¼w	147868	1		
R19	Res, var, cer met, 100Ω ±20%, ½w	193052	1		
R20	Res, comp, 6.8k ±5%, ¼w	148098	1		
R21	Res, comp, 22Ω ±5%, ¼w	147884	1		
T1	Transformer, var, nom, 2.2 uh	172965	1		
	Tuner can, L4	224782	1		
	Socket, I. C., (used with I. C. 2, I. C. 3)	276527	2		

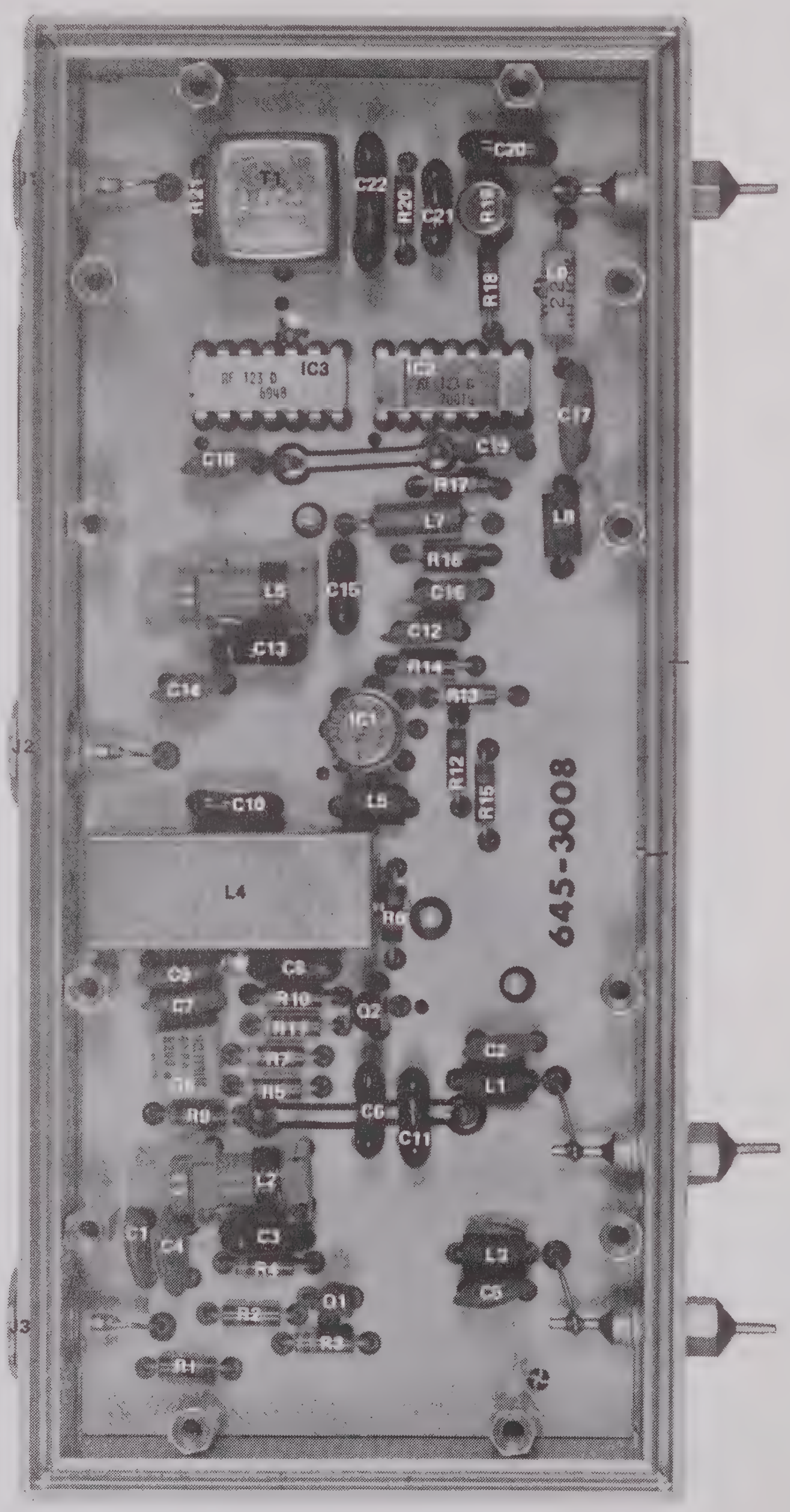

J1
T1
R21
C22
R20
C21
C20
R18
IC3
IC2
C17
C18
C19
R17
L7
L8
R16
L5
C15
C16
C12
C13
C14
R14
R13
IC1
J2
R12
R15
C10
L4
645-3008
C8
C7
R10
R11
Q2
R7
C2
L1
R5
C6
C11
L2
C1
C4
C3
L3
C5
Q1
R2
J3
R3
R1

Figure 5-9. 40 MHz 10/1 DIVIDER MODULE (645-4109), 30 MHz 10/1 DIVIDER MODULE (645-4108)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A10	**30 MHz 10/1 DIVIDER MODULE (645-4108) Figure 5-9**	263202	REF		
A1	30 MHz 10/1 Divider PCB Assembly (See Figure 5-9)	264176	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Frame, enclosure	269530	1		
	Cover, enclosure	269514	2		
	30 MHz 10/1 DIVIDER PCB ASSEMBLY - Figure 5-9	264176	REF		
C1, C2, C4, C5, C7, C9, C12, C14, C16, C18, C19	Cap, cer, 0.0012 uf ±10%, 500v	106732	11		
C3, C13, C21	Cap, mica, 180 pf ±1%, 500v	284786	3		
C6	Cap, mica, 15 pf ±5%, 500v	148569	1		
C8	Cap, mica, 200 pf ±1%, 500v	284794	1		
C10, C20	Cap, mica, 22 pf ±5%, 500v	148551	2		
C11	Cap, mica, 12 pf ±5%, 500v	175224	1		
C15	Cap, mica, 47 pf ±5%, 500v	148536	1		
C17	Cap, cer, 0.05 uf ±20%, 100v	149161	1		
C22	Cap, mica, 1000 pf ±5%, 500v	148387	1		
IC1	IC, differential/cascode amplifier	246256	1		
IC2, IC3	IC, TTL, Dual J-K Flip Flop	267260	2		
L1, L3, L5, L8	Ferrite bead	219535	4		
L2, L4, L6	Inductor, RF, 4 turns, 25 MHz	255497	3		
L7	Inductor, 10 uh, 432 ma	249078	1		
L9	Inductor, 22 uh, 590 ma	147843	1		
Q1, Q2	Tstr, silicon, NPN	248351	2		
R1, R6	Res, comp, 56Ω ±5%, ¼w	147900	2		
R2	Res, comp, 27Ω ±5%, ¼w	160812	1		
R3, R9	Res, comp, 3.3k ±5%, ¼w	148056	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R4, R10, R14	Res, comp, 4.7k ±5%, ¼w	148072	3		
R5, R11, R13	Res, comp, 470Ω ±5%, ¼w	147983	3		
R7	Res, comp, 47Ω ±5%, ¼w	147892	1		
R8	Res, var, comp, 200Ω ±20%, ½w	203828	1		
R12	Res, comp, 1k ±5%, ¼w	148023	1		
R15	Res, comp, 2.7k ±5%, ¼w	170720	1		
R16	Res, comp, 270Ω ±5%, ¼w	160804	1		
R17	Res, comp, 680Ω ±5%, ¼w	148007	1		
R18	Res, comp, 10Ω ±5%, ¼w	147868	1		
R19	Res, var, cer met, 100Ω ±20%, ½w	193052	1		
R20	Res, comp, 3.9k ±5%, ¼w	148064	1		
R21	Res, comp, 22Ω ±5%, ¼w	147884	1		
T1	Transformer, var, nom, 2.2 uh	172965	1		
	Tuner can, L4	224782	1		
	Socket, I. C. (used with I.C. 2)	276527	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3A11	**BUS BLOCK ASSEMBLY (645-4240)**	274548	REF		
A1	Bus Block PCB Assembly	274530	1		
J1, J3, J5	Connector, female, coaxial	215301	3		
J2, J4	Connector, male, coaxial	272302	2		
J6	RF Cable No. 5	270231	1		
A1	BUS BLOCK PCB ASSEMBLY	274530	REF		
C1	Cap, cer, 0.005 uf ±20%, 50v	255471	1		
CR1 thru CR5	Diode, germanium, 80 ma, 100 piv	149187	5		
R1	Res, comp, 1k ±5%, ¼w	148023	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4	**SUBSYNTHESIZER TRAY ASSEMBLY - Figure 5-10**	263780	REF		
A1	36 MHz Mixer Module (645-4125) (See Figure 5-11)	263277	1	1	
A2	37 MHz Mixer Module (645-4126) (See Figure 5-12)	273285	1	1	
A3	38 MHz Mixer Module (645-4127) (See Figure 5-12)	263293	1	1	
A4	32 MHz Mixer Module (645-4122) (See Figure 5-12)	263244	1	1	
A5	31 MHz Mixer Module (645-4121) (See Figure 5-11)	263236	1	1	
A6	39 MHz Mixer Module (645-4128) (See Figure 5-11)	263301	1	1	
A7	34 MHz Mixer Module (645-4124) (See Figure 5-11)	263269	1	1	
A8	33 MHz Mixer Module (645-4123) (See Figure 5-12)	263251	1	1	
A9	30-39 MHz Gate Module (645-4133) (See Figure 5-13)	263350	1	1	
A10	30-35 MHz Filter Module (645-4129-1) (See Figure 5-14)	263319	1	1	
A11	32-37 MHz Filter Module (645-4129-3) (See Figure 5-14)	270371	1	1	
A12	34-39 MHz Filter Module (645-4129-5) (See Figure 5-14)	270389	1	1	
A13	31-36 MHz Filter Module (645-4129-2) (See Figure 5-14)	270363	1	1	
A14	33-38 MHz Filter Module (645-4129-4) (See Figures 5-14 & 5-15)	263327	1	1	
A15	Gate Matrix Module (645-4234) (See Figure 5-16)	264507	1		
A16	Digit Adder Mixer Filter No. 2 Module (645-4142) (See Figure 5-17)	263442	1	1	
A17	Digit Adder Mixer No. 1 Module (645-4139) (See Figure 5-18)	263418	1	1	
A18	Digit Adder Mixer No. 2 Module (645-4141) (See Figure 5-19)	263434	1	1	
A19	10/1 Divider No. 1 Module (645-4136-3) (See Figure 5-20)	263384	1	1	
A20	Digit Adder Mixer Filter No. 3 Module (645-4143) (See Figure 5-21)	263475	1	1	
A21	Digit Adder Filter/Search Oscillator Filter Module (645-4129-6) (See Figures 5-22 & 5-23)	263335	1	1	
A22	Search Mixer Module (645-4146) (See Figure 5-18)	263483	1		
A23	Search VCO Module (644-4124) (See Figure 5-24)	254003	1	1	
A24	Digit Shift Mixer No. 2 Module (645-4138-2) (See Figure 5-25)	275008	1		
A25	10/1 Divider No. 2 Module (645-4149-2) (See Figure 5-26)	275016	1		
A26	Digit Shift Mixer No. 1 Module (645-4137-1) (See Figure 5-25)	263392	1	1	
A27	10/1 Divider No. 1 Module (645-4136-2) (See Figure 5-20)	270421	1		

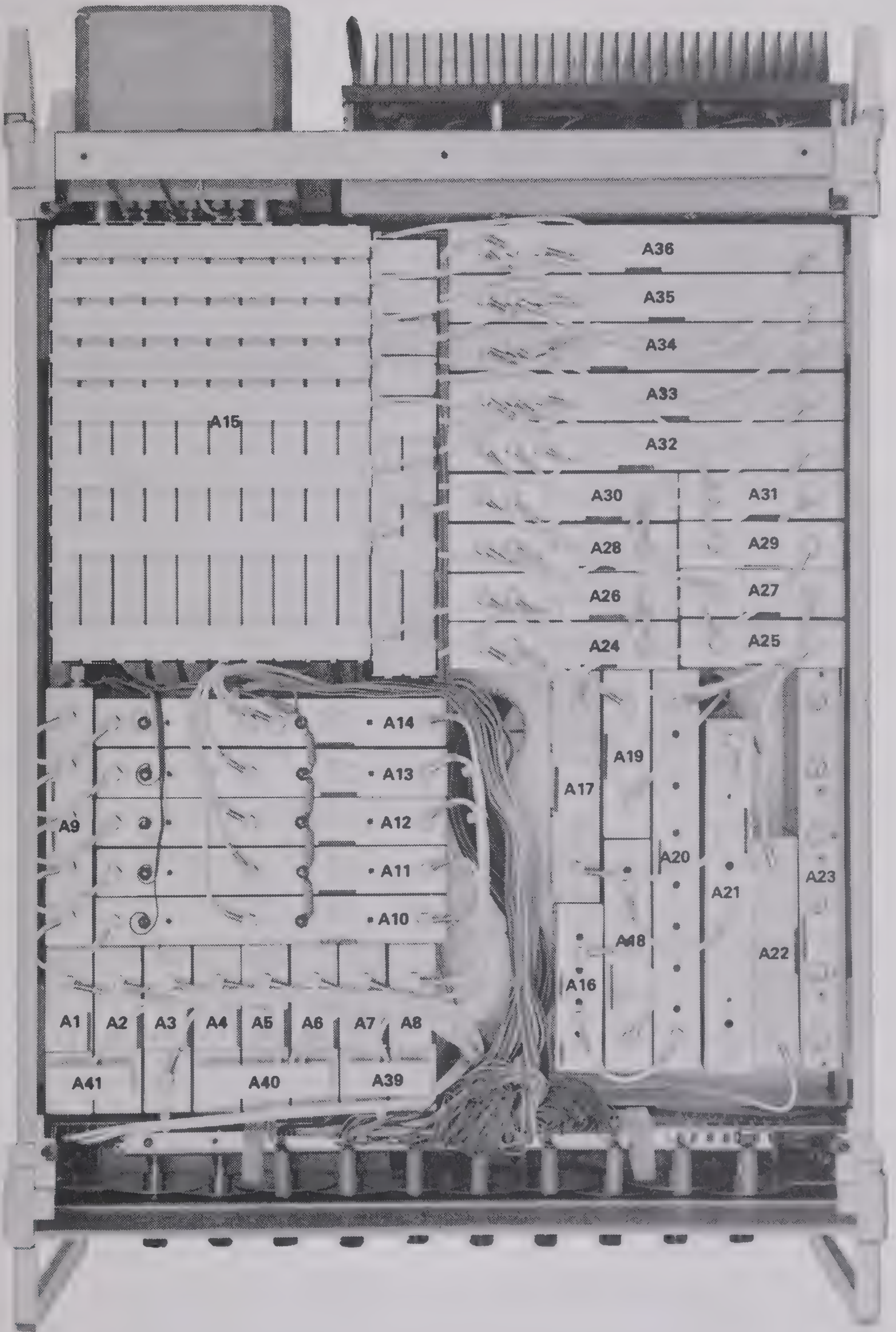
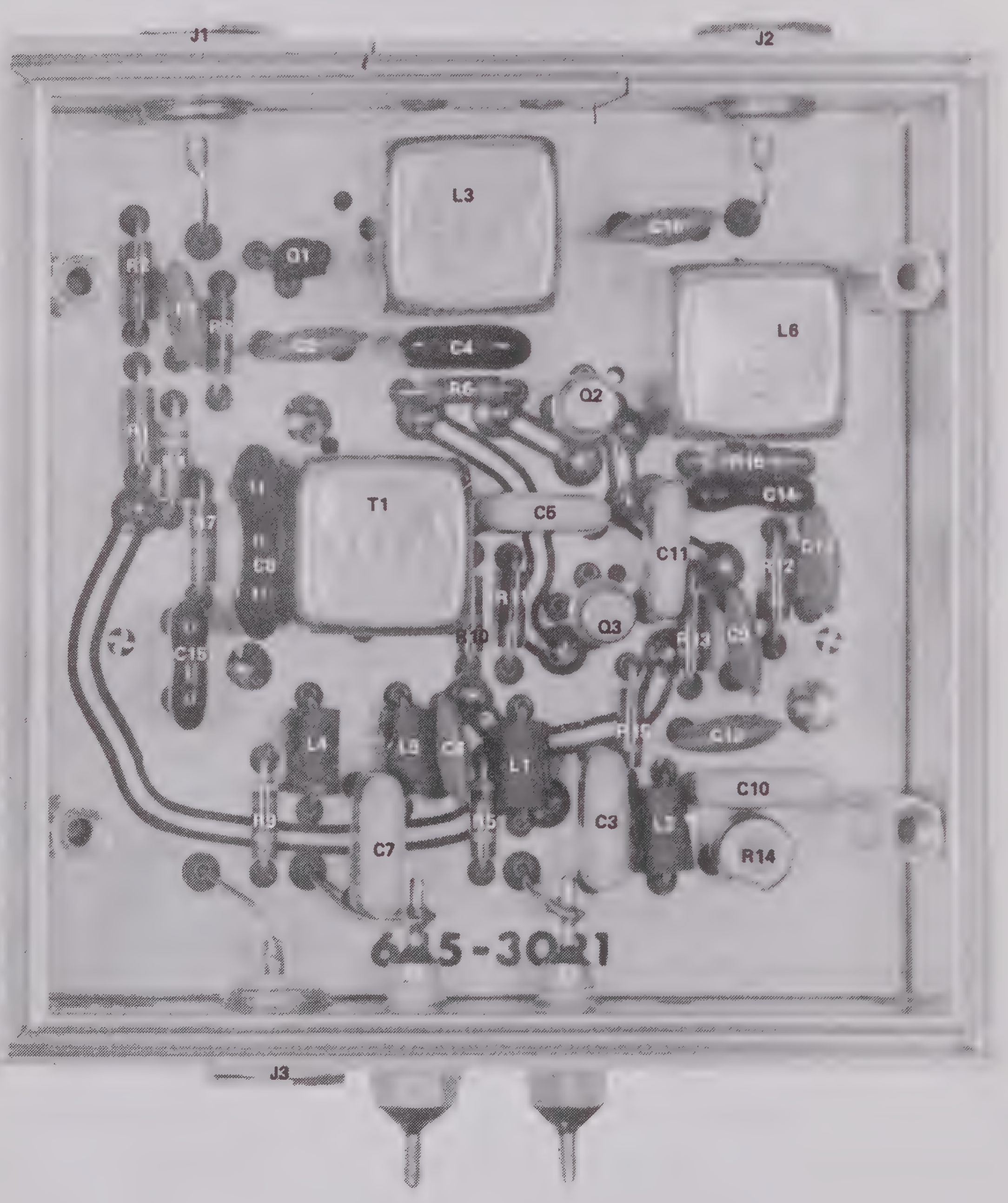

A36
A35
A34
A33
A32
A15
A30
A31
A28
A29
A26
A27
A24
A25
A14
A13
A12
A11
A10
A9
A19
A17
A20
A21
A23
A18
A22
A16
A1
A2
A3
A4
A5
A6
A7
A8
A41
A40
A39

Figure 5-10. SUBSYNTHESIZER TRAY ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A28	Digit Shift Mixer No. 2 Module (645-4138-1) (See Figure 5-25)	263400	1	1	
A29	10/1 Divider No. 2 Module (645-4149-1) (See Figure 5-26)	263517	1	1	
A30	Digit Shift Mixer No. 1 Module (645-4137-2) (See Figure 5-25)	263392	1		
A31	10/1 Divider No. 1 Module (645-4136-1) (See Figure 5-20)	270413	1		
A32	Digit Shift Mixer Module (645-4135) (See Figure 5-27)	263376	5	2	
A33	Digit Shift Mixer Module (645-4135) (See Figure 5-27)	263376	REF		
A34	Digit Shift Mixer Module (645-4135) (See Figure 5-27)	263376	REF		
A35	Digit Shift Mixer Module (645-4135) (See Figure 5-27)	263376	REF		
A36	Digit Shift Mixer Module (645-4135) (See Figure 5-27)	263376	REF		
A37	3 MHz Bus Block Assembly (645-4235)	273904	1		
A38	4 MHz Bus Block Assembly (645-4236)	273912	1		
A39	30 MHz Bus Block Assembly (645-4237)	273920	1		
A40	35 MHz Bus Block Assembly (645-4238)	273938	1		
A41	40 MHz Bus Block Assembly (645-4239)	273946	1		
CR1	Diode, zener 10w, 6.8v (underneath A15)	272757	1		
L1 thru L19	Ferrite bead	219535	38		
TB1	Terminal Board (underneath A15)	269423	1		
	RF Cable No. 46	205906	1		
	RF Cable No. 47	205872	1		
	RF Cable No. 48	205898	1		
	RF Cable No. 49, 98, 103	205815	3		
	RF Cable No. 50, 97	205823	2		
	RF Cable No. 51	205849	1		
	RF Cable No. 52, 53, 99, 101, 104, 106, 108 thru 112	205799	11	1	
	RF Cable No. 55 thru 64, 93, 94, 96, 102, 107	205757	15	1	
	RF Cable No. 95	205773	1		
	RF Cable No. 100, 105	205765	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A1	**36 MHz MIXER MODULE (645-4125) Figure 5-11**	263277	REF		
A1	36 MHz Mixer PCB Assembly (See Figure 5-11)	264242	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	36 MHz MIXER PCB ASSEMBLY - Figure 5-11	264242	REF		
C1, C2, C8, C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4	Cap, mica, 68 pf ±5%, 500v	148510	1		
C6	Cap, mica, 820 pf ±5%, 500v	148395	1		
C14	Cap, mica, 150 pf ±5%, 500v	148478	1		
C15	Cap, mica, 82 pf ±5%, 500v	148502	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		


J1
J2
L3
Q1
C16
R2
R3
L6
C2
C4
R6
Q2
R1
R16
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T1
C5
R7
C8
C11
R12
C17
R11
Q3
C15
R10
R13
C9
L4
L5
C6
L1
R15
C12
C10
R9
R5
C3
L2
C7
R14
645-3021
J3

Figure 5-11. 31 MHz MIXER MODULE (645-4121), 34 MHz MIXER MODULE (645-4124)
36 MHz MIXER MODULE (645-4125), 39 MHz MIXER MODULE (645-4128)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R10	Res, comp, 10k ±5%, ¼w	148106	1		
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A2	**37 MHz MIXER MODULE (645-4126) Figure 5-12**	263285	REF		
A1	37 MHz Mixer PCB Assembly (See Figure 5-12)	264259	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	37 MHz MIXER PCB ASSEMBLY - Figure 5-12	264259	REF		
C1, C2, C8, C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 ±10%, 250v	162008	5		
C4	Cap, mica, 68 pf ±5%, 500v	148510	1		
C6	Cap, mica, 1000 pf ±5%, 500v	148387	1		
C14	Cap, mica, 150 pf ±5%, 500v	148478	1		
C15	Cap, mica, 82 pf ±5%, 500v	148502	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		

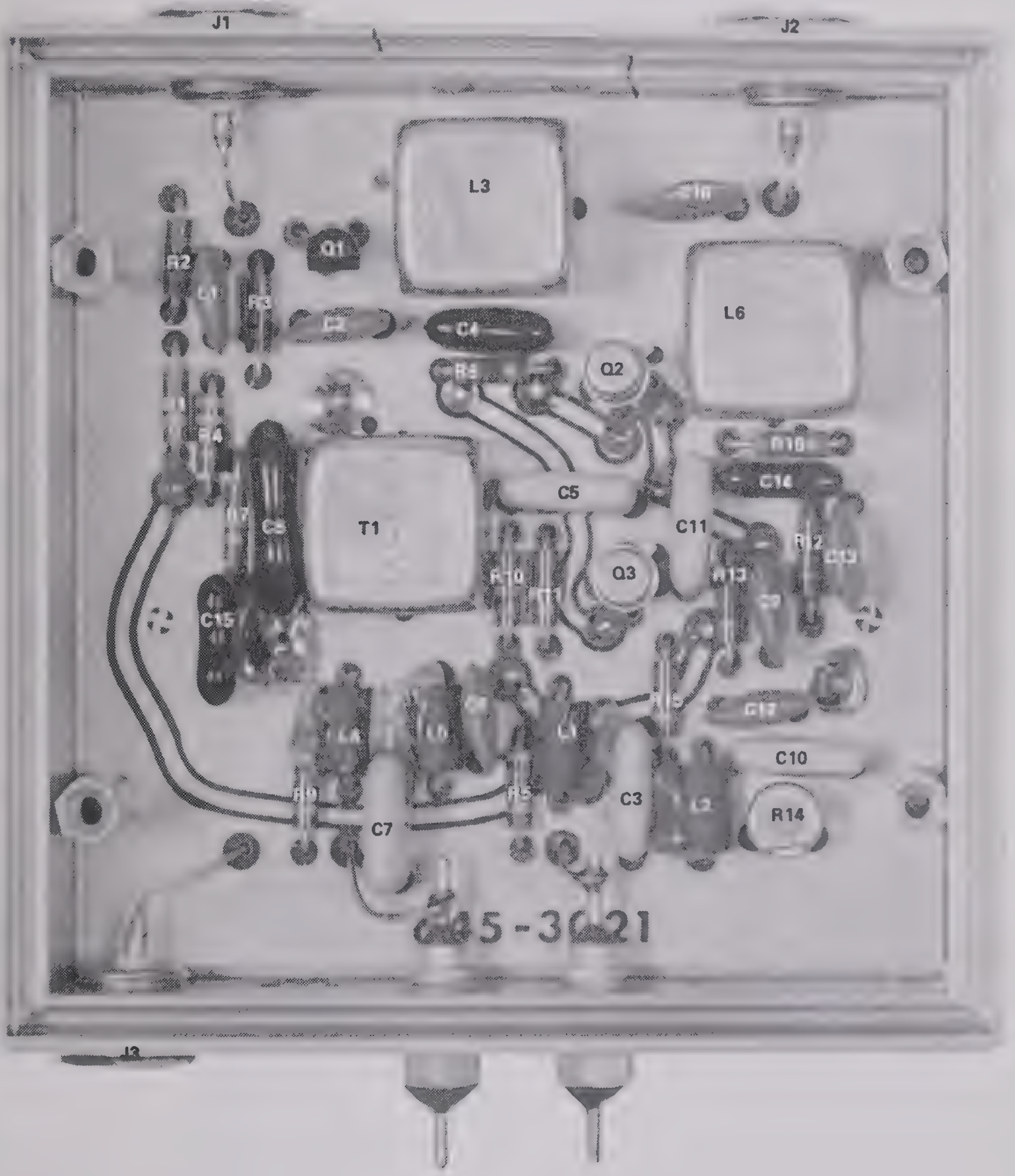
J1
J2
L3
Q1
R2
L1
R3
C2
C4
Q2
L6
R15
C14
R4
C5
C11
T1
R7
C6
R10
R11
Q3
R13
R12
C13
C9
C15
C17
L4
L5
C1
C10
R9
R5
C3
L2
R14
C7
645-3021
J3

Figure 5-12. 32 MHz MIXER MODULE (645-4122), 33 MHz MIXER MODULE (645-4123)
37 MHz MIXER MODULE (645-4126), 38 MHz MIXER MODULE (645-4127)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A3	**38 MHz MIXER MODULE (645-4127) Figure 5-12**	263293	REF		
A1	38 MHz Mixer PCB Assembly (See Figure 5-12)	264267	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, enclosure	207084	1		
	38 MHz MIXER PCB ASSEMBLY - Figure 5-12	264267	REF		
C1, C2, C8, C9, C12 C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4, C15	Cap, mica, 82 pf ±5%, 500v	148502	2		
C6	Cap, mica, 1000 pf ±5%, 500v	148387	1		
C14	Cap, mica, 120 pf ±5%, 500v	148486	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A4	**32 MHz MIXER MODULE (645-4122) - Figure 5-12**	263244	REF		
A1	32 MHz Mixer PCB Assembly (See Figure 5-12)	264218	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	32 MHz MIXER PCB ASSEMBLY - Figure 5-12	264218	REF		
C1, C2, C8 C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4, C15	Cap, mica, 82 pf ±5%, 500v	148502	2		
C6	Cap, mica, 1000 pf ±5%, 500v	148387	1		
C14	Cap, mica, 220 pf ±5%, 500v	170423	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A5	**31 MHz MIXER MODULE (645-4121) - Figure 5-11**	263236	REF		
A1	31 MHz Mixer PCB Assembly (See Figure 5-11)	264200	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	31 MHz MIXER PCB ASSEMBLY - Figure 5-11	264200	REF		
C1, C2, C8 C9, C12 C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4, C15	Cap, mica, 82 pf ±5%, 500v	148502	2		
C6	Cap, mica, 820 pf ±5%, 500v	148395	1		
C14	Cap, mica, 220 pf ±5%, 500v	170423	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A6	**39 MHz MIXER MODULE (645-4128) - Figure 5-11**	263301	REF		
A1	39 MHz Mixer PCB Assembly (See Figure 5-11)	264275	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	39 MHz MIXER PCB ASSEMBLY - Figure 5-11	264275	1		
C1, C2, C8, C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4, C15	Cap, mica, 82 pf ±5%, 500v	148502	2		
C6	Cap, mica, 820 pf ±5%, 500v	148395	1		
C14	Cap, mica, 120 pf ±5%, 500v	148486	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A7	**34 MHz MIXER MODULE (645-4124) – Figure 5-11**	263269	REF		
A1	34 MHz Mixer PCB Assembly (See Figure 5-11)	264234	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	34 MHz MIXER PCB ASSEMBLY - Figure 5-11	264234	REF		
C1, C2, C8, C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4	Cap, mica, 100 pf ±5%, 500v	148494	1		C
C4	Cap, mica, 120 pf ±5%, 500v	148486	1		D
C6	Cap, mica, 820 pf ±5%, 500v	148395	1		
C14	Cap, mica, 180 pf ±5%, 500v	148460	1		
C15	Cap, mica, 82 pf ±5%, 500v	148502	1		
L1, L2 L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A8	**33 MHz MIXER MODULE (645-4123) - Figure 5-12**	263251	REF		
A1	33 MHz Mixer PCB Assembly (See Figure 5-12)	264226	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264887	1		
	Cover, enclosure	252916	2		
	Plug, threaded	207084	1		
	33 MHz MIXER PCB ASSEMBLY - Figure 5-12	264226	REF		
C1, C2, C8, C9, C12, C13, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C3, C5, C7, C10, C11	Cap, plstc, 0.047 uf ±10%, 250v	162008	5		
C4	Cap, mica, 120 pf ±5%, 500v	148486	1		
C6	Cap, mica, 1000 pf ±5%, 500v	148387	1		
C14	Cap, mica, 220 pf ±5%, 500v	170423	1		
C15	Cap, mica, 82 pf ±5%, 500v	148502	1		
L1, L2, L4, L5	Ferrite bead	219535	4		
L3	Inductor, var, nom, 0.25 uh	253294	1		
L6	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	248351	1		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 8.2k ±5%, ¼w	160796	1		
R2, R13, R15	Res, comp, 2.7k ±5%, ¼w	170720	3		
R3, R12	Res, comp, 100Ω ±5%, ¼w	147926	2		
R4	Res, comp, 3.3k ±5%, ¼w	148056	1		
R5, R9	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R16	Res, comp, 6.8k ±5%, ¼w	148098	2		
R7	Res, comp, 12k ±5%, ¼w	159731	1		
R10	Res, comp, 10k ±5%, ¼w	148106	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R11	Res, comp, 1.2k ±5%, ¼w	190371	1		
R14	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A9	**30-39 MHz GATE MODULE (645-4133) - Figure 5-13**	263350	REF		
A1	30-39 MHz Gate PCB Assembly (See Figure 5-13)	252569	1		
J1 thru J11	Connector, male, coaxial	207639	11		
	Cap, feed thru, 2500 pf gmv	248286	1		
	Frame, enclosure	264952	1		
	Cover, enclosure	252957	2		
	30-39 MHz GATE PCB ASSEMBLY - Figure 5-13	252569	REF		
C1, C4, C7, C10, C13 C18 thru C23, C26, C29, C32, C36, C38	Cap, cer, 0.0012 uf ±10%, 500v	106732	16		
C2, C5, C8, C11, C14, C24, C27, C30, C33, C35	Cap, mica, 47 pf ±5%, 500v	148536	10		
C3, C6, C9, C12, C15, C25, C28, C31, C34, C37	Cap, cer, 0.005 uf ±20%, 50v	255471	10		
C16	Cap, mica, 4 pf ±5%, 500v	190397	1		
C17,C39	Cap, mica, 2 pf ±0.5 pf, 500v	175208	2		
IC1	IC, differential/cascode amplifier	246256	1		
L1 thru L12	Ferrite bead	219535	12		
L13	Inductor, var, nom, 1.3 uh	172973	1		
Q1 thru Q20	Tstr, silicon, NPN	248351	20		
R1, R7, R14, R20, R28, R40, R47, R53, R59, R67	Res, comp, 470Ω ±10%, 1/8w	153981	10		
R2, R4, R8, R10, R13, R17, R19, R23, R25, R27, R43, R45, R49,	Res, comp, 100Ω ±10%, 1/8w	261826	20		

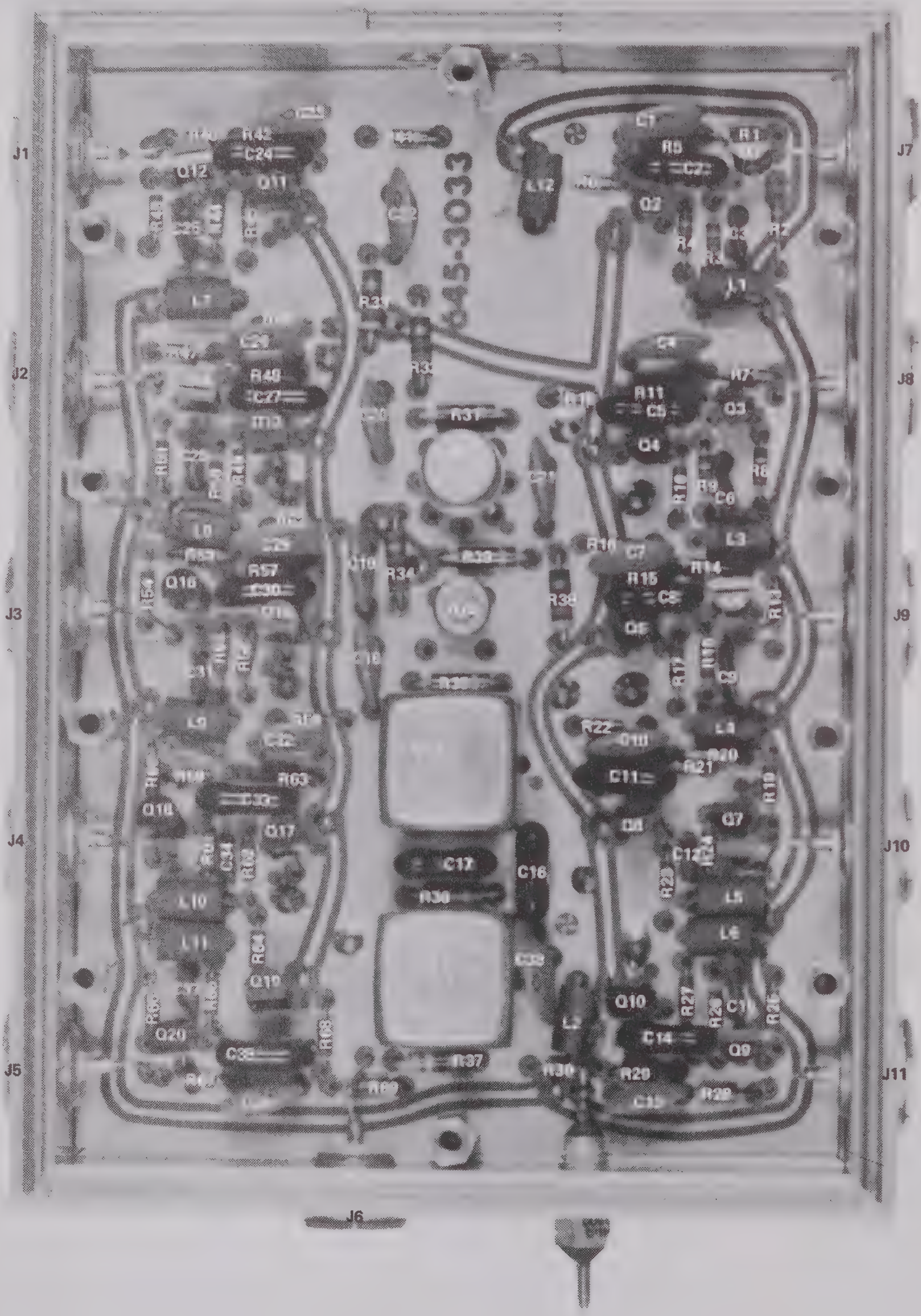
J1
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
645-3033
R42
C24
Q12
Q11
L7
C26
R48
C27
R33
R32
R31
R34
Q19
R35
R36
R37
C17
C16
R30
L8
R57
C30
Q16
L9
R63
C33
Q18
Q17
C34
L10
L11
R64
Q20
C35
R69
C1
R5
R1
C2
L12
Q2
R4
C3
R2
L1
C4
R7
R11
C5
Q3
Q4
R8
R10
R9
C6
L3
C7
R14
R15
C8
Q6
C9
R22
R20
R21
C11
R19
Q8
Q7
C12
R24
R23
L5
L6
Q10
R27
C13
R26
C14
Q9
R29
R28
C15

Figure 5-13. 30-39 MHz GATE MODULE (645-4133)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R51, R54, R56, R60, R62, R64, R66	Res, comp, 100Ω ±10%, 1/8w	261826	REF		
R3, R9, R18, R24, R26, R44, R50, R55, R61, R65	Res, comp, 270Ω ±10%, 1/8w	261834	10		
R5, R11, R15, R21, R29, R42, R48, R57, R63, R68	Res, comp, 1k ±10%, 1/8w	153916	10		
R6, R12, R16, R22, R30, R41, R46, R52, R58, R69	Res, comp, 6.8k ±10%, 1/8w	246967	10		
R31	Res, comp, 1k ±5%, ¼w	148023	1		
R32	Res, comp, 270Ω ±5%, ¼w	160804	1		
R33	Res, comp, 47Ω ±5%, ¼w	147892	1		
R34	Res, comp, 100Ω ±5%, ¼w	147926	1		
R35, R36, R39	Res, comp, 2.2k ±5%, ¼w	148049	3		
R37	Res, comp, 33Ω ±5%, ¼w	175034	1		
R38	Res, comp, 4.7k ±5%, ¼w	148072	1		
R70	Res, var, cer met, 5k ±20%, ½w	226084	1		
T1	Transformer, var, nom, 1.3 uh	172981	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A10	**30-35 MHz FILTER MODULE (645-4129-1) - Figure 5-14**	263319	REF		
A1	30, 31 &32 MHz Filter PCB Assembly (See Figure 5-14)	264309	1		
A2	34 & 35 MHz Filter PCB Assembly (See Figure 5-14)	252551	1		
J1 thru J6	Connector, male, coaxial	207639	6		
	Cap, feed thru, 2500 pf gmv	248286	4		
	Ferrite bead	219535	2		
	Frame, enclosure	264911	2		
	Cover, enclosure	252940	4		
	30, 31 & 32 MHz FILTER PCB ASSEMBLY - Figure 5-14	264309	REF		
C1, C3, C5, C7, C9, C14, C18, C20	Cap, mica, 22 pf ±5%, 500v	148551	8		
C2, C4, C6, C8, C17, C19, C21	Cap, mica, 180 pf ±5%, 500v	148460	7		
C10 thru C13, C15, C16, C23, C26, C32	Cap, cer, 0.005 uf ±20%, 50v	255471	9		
C22, C24, C28	Cap, cer, 0.0012 uf ±10%, 500v	106732	3		
C25	Cap, mica, 47 pf ±5%, 500v	148536	1		
C27	Cap, mica, 220 pf ±5%, 500v	170423	1		
L1 thru L7	Inductor, var, nom, 0.140 uh	253310	7		
L8, L10, L11	Ferrite bead	219535	3		
Q1 thru Q4	Tstr, silicon, PNP	226290	4		
Q5, Q6	Tstr, silicon, NPN	248351	2		
R1	Res, comp, 82Ω ±10%, 1/8w	266247	1		
R2, R3, R10, R13	Res, comp, 6.8k ±10%, 1/8w	246967	4		
R4, R7, R8, R11	Res, comp, 1.5k ±10%, 1/8w	153932	4		
R5, R12	Res, comp, 27Ω ±10%, 1/8w	266254	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R6, R19, R23	Res, comp, 1k ±10%, 1/8w	153916	3		
R9, R16	Res, comp, 270Ω ±10%, 1/8w	261834	2		
R14, R21	Res, comp, 51Ω ±10%, 1/8w	266262	2		
R15, R18, R20	Res, comp, 100Ω ±10%, 1/8w	261826	3		
R17	Res, comp, 3.9k ±10%, 1/8w	267377	1		
R22	Res, comp, 470Ω ±10%, 1/8w	153981	1		
	34 & 35 MHz FILTER PCB ASSEMBLY - Figure 5-14	252551	REF		
C1, C3, C5, C7, C9, C14, C18, C20	Cap, mica, 18 pf ±5%, 500v	266585	8		
C2, C4, C6, C8, C17, C19, C21	Cap, mica, 150 pf ±5%, 500v	148478	7		
C10 - C13, C15, C16, C23, C26, C32	Cap, cer, 0.005 uf ±20%, 500v	255471	9		
C22, C24, C28	Cap, cer, 0.0012 uf ±10%, 500v	106732	3		
C25	Cap, mica, 47 pf ±5%, 500v	148536	1		
C27	Cap, mica, 220 pf ±5%, 500v	170423	1		
L1 thru L7	Inductor, var, nom, 0.140 uh	253310	7		
L8, L10, L11	Ferrite bead	219535	3		
Q1 thru Q4	Tstr, silicon, PNP	226290	4		
Q5, Q6	Tstr, silicon, NPN	248351	2		
R1	Res, comp, 82Ω ±10%, 1/8w	266247	1		
R2, R3, R10, R13	Res, comp, 6.8k ±10%, 1/8w	246967	4		
R4, R7, R8, R11	Res, comp, 1.5k ±10%, 1/8w	153932	4		
R5, R12	Res, comp, 27Ω ±10%, 1/8w	266254	2		
R6, R19, R23	Res, comp, 1k ±10%, 1/8w	153916	3		
R9, R16	Res, comp, 270Ω ±10%, 1/8w	261834	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14, R21	Res, comp, 51Ω ±10%, 1/8w	266262	2		
R15, R18, R20	Res, comp, 100Ω ±10%, 1/8w	261826	3		
R17	Res, comp, 3.9k ±10%, 1/8w	267377	1		
R22	Res, comp, 470Ω ±10%, 1/8w	153981	1		

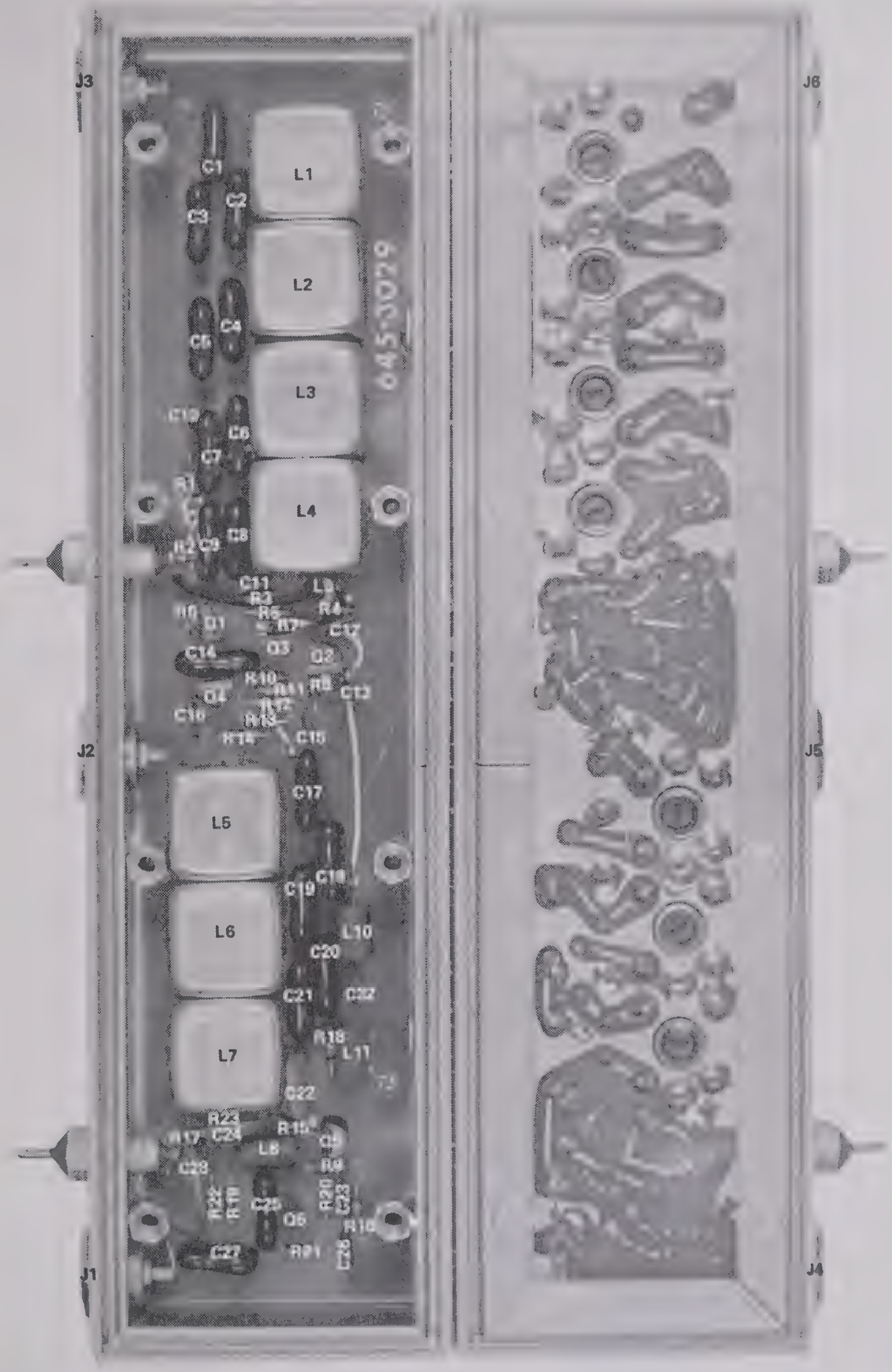
J3
J6
C1
L1
C2
C3
L2
C4
C5
645-3029
L3
C10
C6
C7
R1
L4
C8
R2
C9
C11
R3
L9
R5
R4
R6
D1
R7
C12
C14
Q3
Q2
R10
R8
Q1
R11
C13
R12
C16
R13
R14
C15
J2
J5
C17
L5
C18
C19
L6
L10
C20
C21
C32
R18
L7
L11
C22
R23
R15
R17
C24
L8
C28
R9
R22
R19
C25
R20
C23
Q5
R16
C27
RP1
C26
J1
J4

Figure 5-14. 30, 31 & 32 MHz FILTER PCB ASSEMBLY, 34 & 35 MHz FILTER PCB ASSEMBLY, AND 36, 37, 38 & 39 MHz FILTER PCB ASSEMBLY, (645-4129-1, -2, -3, -4, -5)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A11	**32-37 MHz FILTER MODULE (645-4129-3) - Figure 5-14**	270371	REF		
A1	30, 31, & 32 MHz Filter PCB Assembly (See Figure 5-14) (Same as A4A10A1)	264309	1		
A2	36, 37, 38 & 39 MHz Filter PCB Assembly (See Figure 5-14)	252544	1		
J1 thru J6	Connector, male, coaxial	207639	6		
	Cap, feed thru, 2500 pf gmv	248286	4		
L9	Ferrite bead	219535	2		
	Frame, enclosure	264911	2		
	Cover, enclosure	252940	4		
	36, 37, 38 & 39 MHz FILTER PCB ASSEMBLY Figure 5-14.	252544	REF		
C1, C3, C5, C7, C9, C14, C18, C20	Cap, mica, 15 pf ±5%, 500v	148569	8		
C2, C4, C6, C8, C17 C19, C21	Cap, mica, 120 pf ±5%, 500v	148486	7		
C10 thru C13, C15 C16, C23, C26, C32	Cap, cer, 0.005 uf ±20%, 50v	255471	9		
C22, C24, C28	Cap, cer, 0.0012 uf ±10%, 500v	106732	3		
C25	Cap, mica, 47 pf ±5%, 500v	148536	1		
C27	Cap, mica, 220 pf ±5%, 500v	170423	1		
L1 thru L7	Inductor, var, nom, 0.140 uh	253310	7		
L8, L10, L11	Ferrite bead	219535	3		
Q1 thru Q4	Tstr, silicon, PNP	226290	4		
Q5, Q6	Tstr, silicon, NPN	248351	2		
R1	Res, comp, 82Ω ±10%, 1/8w	266247	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2, R3, R10, R13	Res, comp, 6.8k ±10%, 1/8w	246967	4		
R4, R7, R8, R11	Res, comp, 1.5k ±10%, 1/8w	153932	4		
R5, R12	Res, comp, 27Ω ±10%, 1/8w	266254	2		
R6, R19, R23	Res, comp, 1k ±10%, 1/8w	153916	3		
R9, R16	Res, comp, 270Ω ±10%, 1/8w	261834	2		
R14, R21	Res, comp, 51Ω ±10%, 1/8w	266262	2		
R15, R18, R20	Res, comp, 100Ω ±10%, 1/8w	261826	3		
R17	Res, comp, 3.9k ±10%, 1/8w	267377	1		
R22	Res, comp, 470Ω ±10%, 1/8w	153981	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A12	**34-39 MHz FILTER MODULE (645-4129-5) - Figure 5-14**	270389	REF		
A1	34 & 35 MHz Filter PCB Assembly (See Figure 5-14) (Same as A4A10A2)	252551	1		
A2	36, 37, 38 & 39 MHz Filter PCB Assembly (See Figure 5-14) (Same as A4A11A2)	252544	1		
J1 thru J6	Connector, male, coaxial	207639	6		
	Cap, feed thru, 2500 pf gmv	248286	4		
L9	Ferrite bead	219535	2		
	Frame, enclosure	264911	2		
	Cover, enclosure	252940	4		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A13	**31-36 MHz FILTER MODULE (645-4129-2) - Figure 5-14**	270363	REF		
A1	30, 31 & 32 MHz Filter PCB Assembly (See Figure 5-14) (Same as A4A10A1)	264309	1		
A2	36, 37, 38 & 39 MHz Filter PCB Assembly (See Figure 5-14) (Same as A4A11A2)	252544	1		
J1 thru J6	Connector, male, coaxial	207639	6		
	Cap, feed thru, 2500 pf gmv	248286	4		
L9	Ferrite bead	219535	2		
	Frame, enclosure	264911	2		
	Cover, enclosure	252940	4		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A14	**33-38 MHz FILTER MODULE (645-4129-4)** **Figures 5-14 & 5-15**	263327	REF		
A1	33 MHz Filter PCB Assembly (See Figure 5-15)	264390	1		
A2	36, 37, 38 &39 MHz Filter PCB Assembly (See Figure 5-14) (same as A4A11A2)	252544	1		
J1 thru J7	Connector, male, coaxial	207639	7		
	Cap, feed thru, 2500 pf gmv	248286	4		
L9	Ferrite bead	219535	2		
	Frame, enclosure	264911	1		
	Frame, enclosure	265827	1		
	Cover, enclosure	252940	4		
	33 MHz FILTER PCB ASSEMBLY - Figure 5-15	252551	REF		
C1, C3, C5, C7, C9, C14, C18, C20, C30	Cap, mica, 18 pf ±5%, 500v	266585	9		
C2, C4, C6, C8, C17, C19, C21	Cap, mica, 150 pf ±5%, 500v	148478	7		
C10 - C13, C15, C16, C23, C26, C29, C31, C32	Cap, cer, 0.005 uf ±20%, 50v	255471	11		
C22, C24, C28	Cap, cer, 0.0012 uf ±10%, 500v	106732	3		
C25	Cap, mica, 47 pf ±5%, 500v	148536	1		
C27	Cap, mica, 220 pf ± 5%, 500V	170423	1		
L1 thru L7	Inductor, var, nom, 0.140 uh	253310	7		
L8, L10, L11	Ferrite bead	219535	3		
Q1 thru Q4, Q7	Tstr, silicon, PNP	226290	5		
Q5, Q6	Tstr, silicon, NPN	248351	2		
R1	Res, comp, 82Ω ±10%, 1/8w	266247	1		

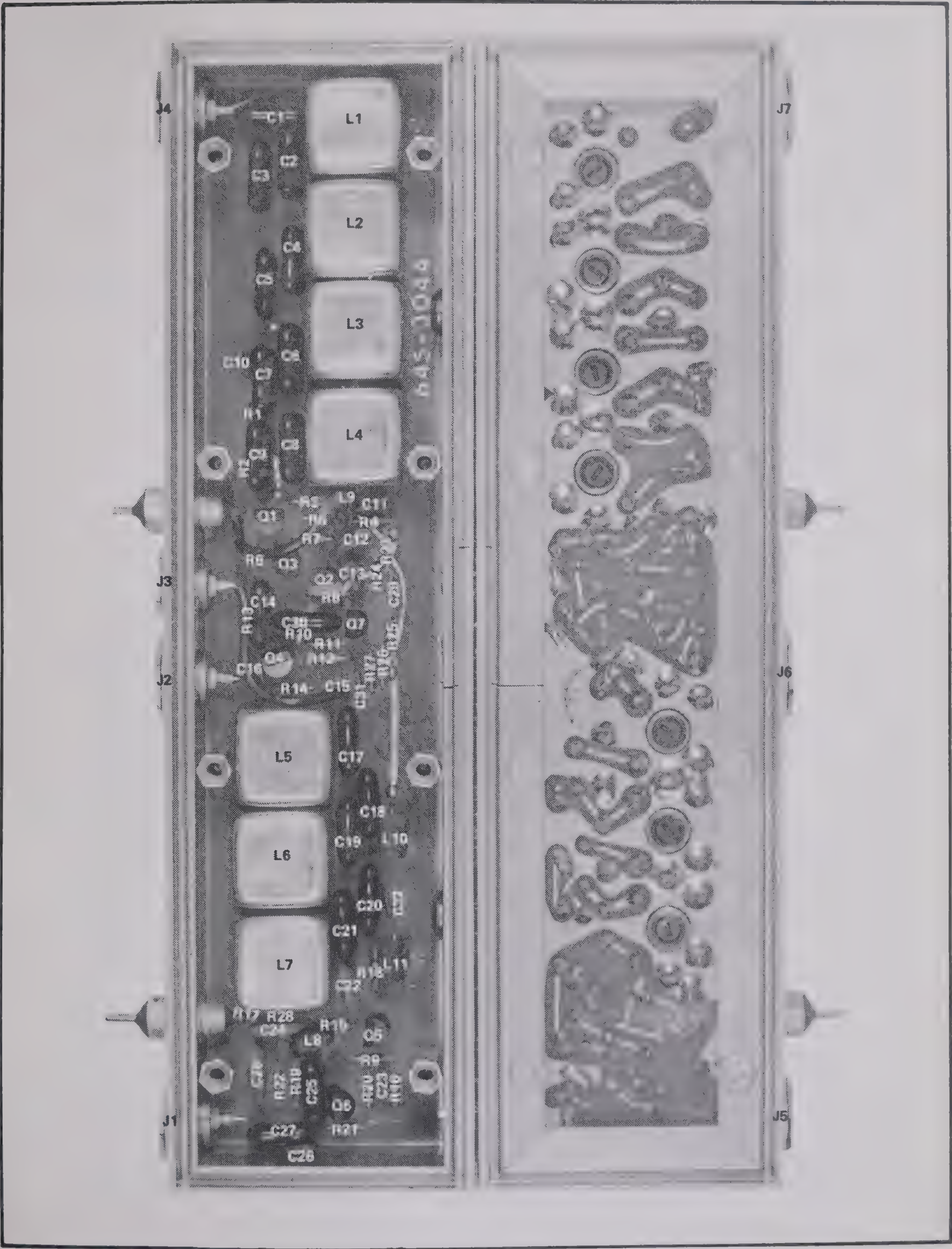
J4
C1
L1
C2
C3
L2
C4
645-3044
L3
C10
C6
C7
R1
L4
C8
R2
R5
L9
C11
Q1
R6
R4
R7
C12
R8
Q3
J3
Q2
C13
R9
C14
R13
C30
Q7
R10
R11
Q4
R12
C16
J2
R14
C15
L5
C17
C18
C19
L10
L6
C20
C21
L7
L11
R18
C22
R17
R28
C24
R16
L8
C5
R9
R22
R19
C25
Q6
R20
C23
J1
C27
R21
C26
J7
J6
J5

Figure 5-15. 33 MHz FILTER PCB ASSEMBLY (645-4129-4)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2, R3, R10, R13, R25, R26	Res, comp, 6.8k ±10%, 1/8w	246967	6		
R4, R7, R8 R11, R23	Res, comp, 1.5k ±10%, 1/8w	153932	5		
R5, R12, R24	Res, comp, 27Ω ±10%, 1/8w	266254	3		
R6, R19, R28	Res, comp, 1k ±10%, 1/8w	153916	3		
R9, R16	Res, comp, 270Ω ±10%, 1/8w	261834	2		
R14, R21, R27	Res, comp, 51Ω ±10%, 1/8w	266262	3		
R15, R18, R20	Res, comp, 100Ω ±10%, 1/8w	261826	3		
R17	Res, comp, 3.9k ±10%, 1/8w	267377	1		
R22	Res, comp, 470Ω ±10%, 1/8w	153981	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A15	**GATE MATRIX MODULE (645-4234) - Figure 5-16**	264507	REF		
A1 thru A12	Gate Matrix PCB Assembly (See Figure 5-16)	252577	12		
J5	Connector, 136 contact	255893	1		
L5 thru L12	Ferrite bead	219535	96		
P1, P3, P5, P7, P9, P11, P13, P15	RF Cable No. 85 thru 92	270082	8		
P2, P8, P10, P12, P14, P16	RF Cable No. 77, 80 thru 84	270090	6		
P4	RF Cable No.78	270108	1		
P6	RF Cable No. 79	270116	1		
P17, P20, P22, P26, P28	RF Cable No. 65, 68, 70, 74, 76	270140	5		
P18	RF Cable No. 66	270173	1		
P19	RF Cable No. 67	270165	1		
P21, P23, P24	RF Cable No. 69, 71, 72	270157	3		
P25	RF Cable No. 73	270132	1		
P27	RF Cable No. 75	270124	1		
R50, R51, R58, R59	Res, comp, 1k ±5%, ¼w	148023	4		
R52 thru R57, R60 thru R65	Res, comp, 270Ω ±5%, ¼w	160804	12		
TB2, TB3	Terminal board	253427	2		
	GATE MATRIX PCB ASSEMBLY - Figure 5-16	252577	REF		
C1 thru C43	Cap, cer, 0.005 uf ±20%, 50v	255471	43		
CR1 thru CR26	Diode, germanium, 80 ma, 100 piv	149187	26		
L1 thru L4	Ferrite bead	219535	4		
Q1, Q2	Tstr, silicon, NPN	248351	2		

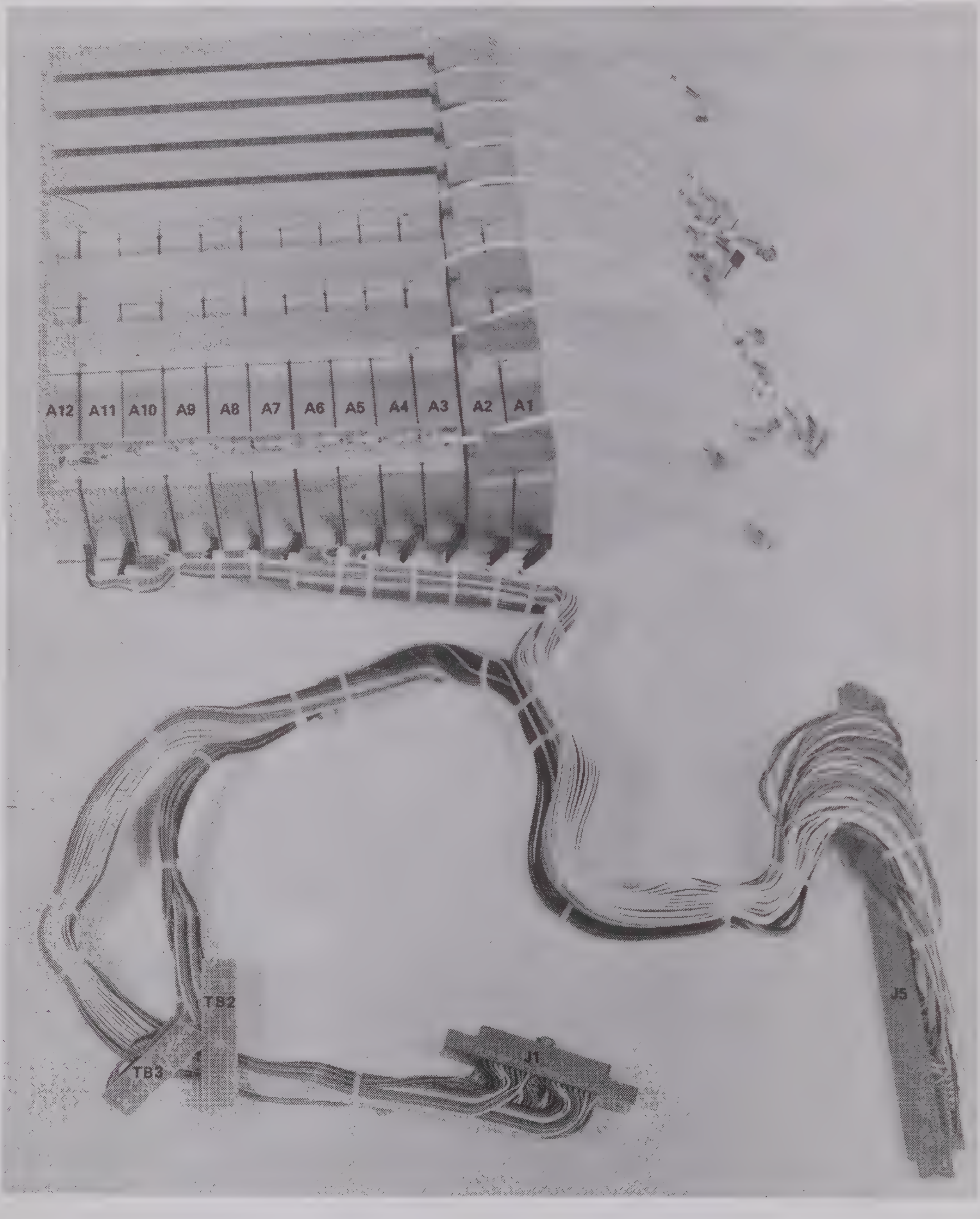
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
TB2
TB3
J1
J5

Figure 5-16. GATE MATRIX MODULE (645-4234) (Sheet 1 of 2)

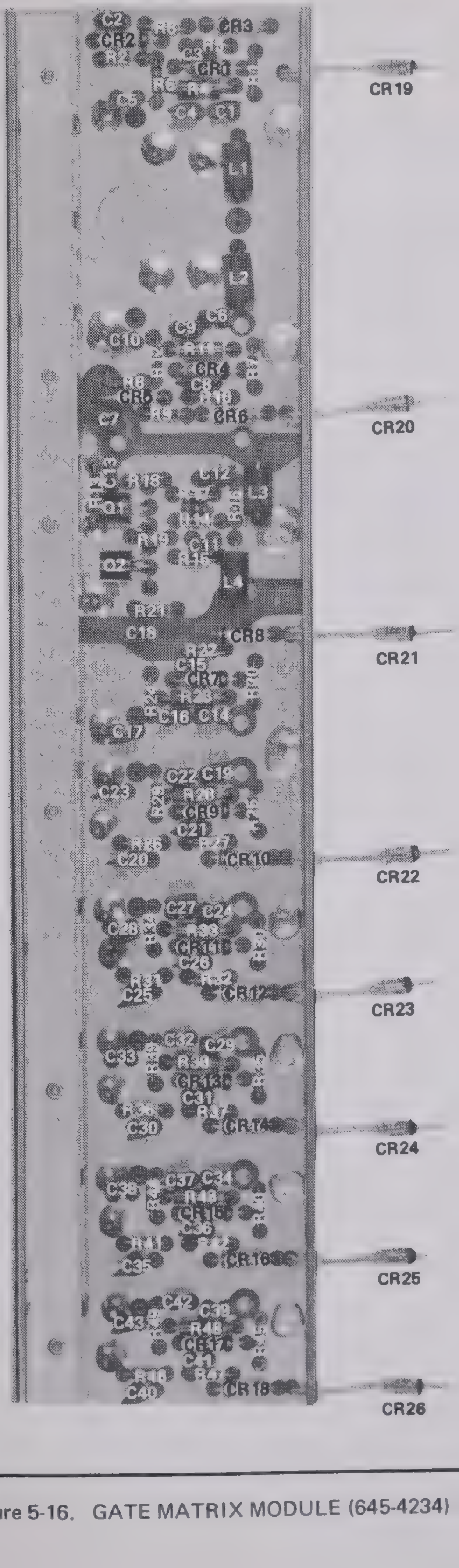
C2
CR2
R2
CR3
C3
CR1
CR19
C5
C4
C1
L1
L2
C6
C9
C10
CR4
C8
CR5
C7
R9
CR6
CR20
C12
R18
L3
Q1
C11
R19
Q2
L4
R21
C18
CR8
CR21
R22
C15
CR7
R23
C16
C14
C17
C22
C19
C23
R28
CR9
C21
R26
R27
C20
CR10
CR22
C27
C24
C28
CR11
C26
R31
C25
CR12
CR23
C32
C29
C33
R39
CR13
C31
R36
R37
C30
CR14
CR24
C37
C34
C38
R48
CR15
C36
R41
C35
CR16
CR25
C42
C39
C43
CR17
C41
C40
CR18
CR26

Figure 5-16. GATE MATRIX MODULE (645-4234) (Sheet 2 of 2)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R1, R7, R14, R18 R20, R25, R30, R35, R40, R45	Res, comp, 10k ±10%, 1/8w	246975	10		
R2, R8	Res, comp, 6.8k ±10%, 1/8w	246967	2		
R3, R9	Res, comp, 470Ω ±10%, 1/8w	153981	2		
R4, R11	Res, comp, 2k ±5%, ¼w	202879	2		
R5, R10, R15, R22, R27, R32, R37, R42, R47	Res, comp, 1.5k ±10%, 1/8w	153932	9		
R6, R12	Res, comp, 820Ω ±10%, 1/8w	153999	2		
R13, R17	Res, comp, 68Ω ±10%, 1/8w	261818	2		
R16	Res, comp, 2.7k ±10%, 1/8w	266239	1		
R19, R21, R26, R31, R36, R41, R46	Res, comp, 270Ω ±10%, 1/8w	261834	7		
R23, R28, R33, R38, R43, R48	Res, comp, 1k ±5%, ¼w	148023	6		
R24, R29, R34, R39, R44, R49	Res, comp, 2.2k ±10%, 1/8w	153965	6		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A16	**DIGIT ADDER MIXER FILTER NO 2 MODULE (645-4142) Figure 5-17**	263442	REF		
A1	Digit Adder Mixer Filter No. 2 PCB Assembly (See Figure 5-17)	264374	1		
J1, J2	Connector, male, coaxial	207639	2		
	Frame, enclosure	265520	2		
	Cover, enclosure	252916	2		
	DIGIT ADDER MIXER FILTER NO. 2 PCB ASSEMBLY Figure 5-17	264374	REF		
C1, C4	Cap, mica, 270 pf ±5%, 500v	148452	2		
C2	Cap, mica, 130 pf ±5%, 500v	266205	1		
C3	Cap, mica, 100 pf ±5%, 500v	148494	1		
C5, C6	Cap, mica, 56 pf ±5%, 500v	148528	2		
L1, L4	Inductor, RF, 50 MHz	269027	2		
L2, L3	Inductor, RF, 4 turns, 25 MHz	255497	2		
L5	Inductor, 0.47 uh, 1400 ma	248047	1		
	Shield, L1 & L3	224782	2		

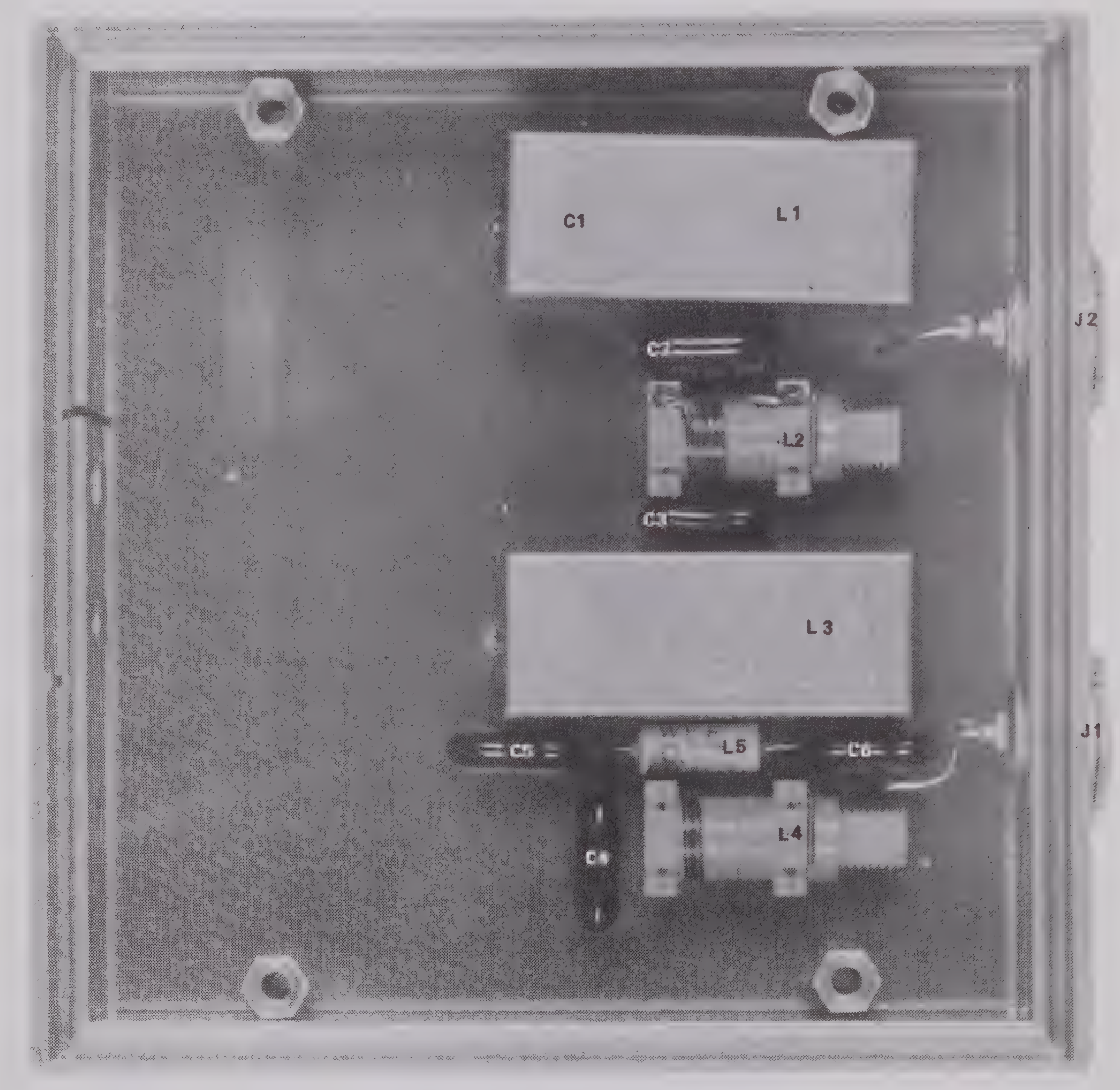
C1
L1
J2
C2
L2
C3
L3
J1
C5
L5
C6
L4
C4

Figure 5-17. DIGIT ADDER MIXER FILTER NO. 2 MODULE (645-4142)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A17	**DIGIT ADDER MIXER NO.1 MODULE (645-4139)** **Figure 5-18**	263418	REF		
A1	Digit Adder Mixer No. 1 PCB Assembly (See Figure 5-18)	264341	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264945	1		
	Cover, enclosure	252973	2		
	DIGIT ADDER MIXER NO. 1 PCB ASSEMBLY Figure 5-18	264341	REF		
C1, C2, C6, C13, C15, C18, C19, C20	Cap, cer, 0.0012 uf ±10%, 500v	106732	8		
C3, C8, C9, C11, C12, C14, C16, C21, C22	Cap, plstc, 0.047 uf ±10%, 250v	162008	9		
C4	Cap, mica, 100 pf ±5%, 500v	148494	1		
C5	Cap, mica, 470 pf ±5%, 500v	148429	1		
C7	Cap, mica, 82 pf ±5%, 500v	148502	1		
C10	Cap, mica, 820 pf ±5%, 500v	148395	1		
C17	Cap, mica, 150 pf ±5%, 500v	148478	1		
L1, L2	Inductor, var, nom, 0.25 uh	253294	2		
L3	Inductor, var, nom, 0.140 uh	253310	1		
L4 thru L7	Ferrite bead	219535	4		
Q1, Q2	Tstr, silicon, NPN	248351	2		
Q3	Tstr, silicon, PNP	215897	1		
Q4, Q5	Tstr, Mos-FET, N-channel	266411	2		
R1, R12, R13, R16	Res, comp, 1.2k ±5%, ¼w	190371	4		
R2	Res, comp, 56Ω ±5%, ¼w	147900	1		
R3	Res, comp, 2k ±5%, ¼w	202879	1		
R4	Res, comp, 560Ω ±5% ¼w	147991	1		

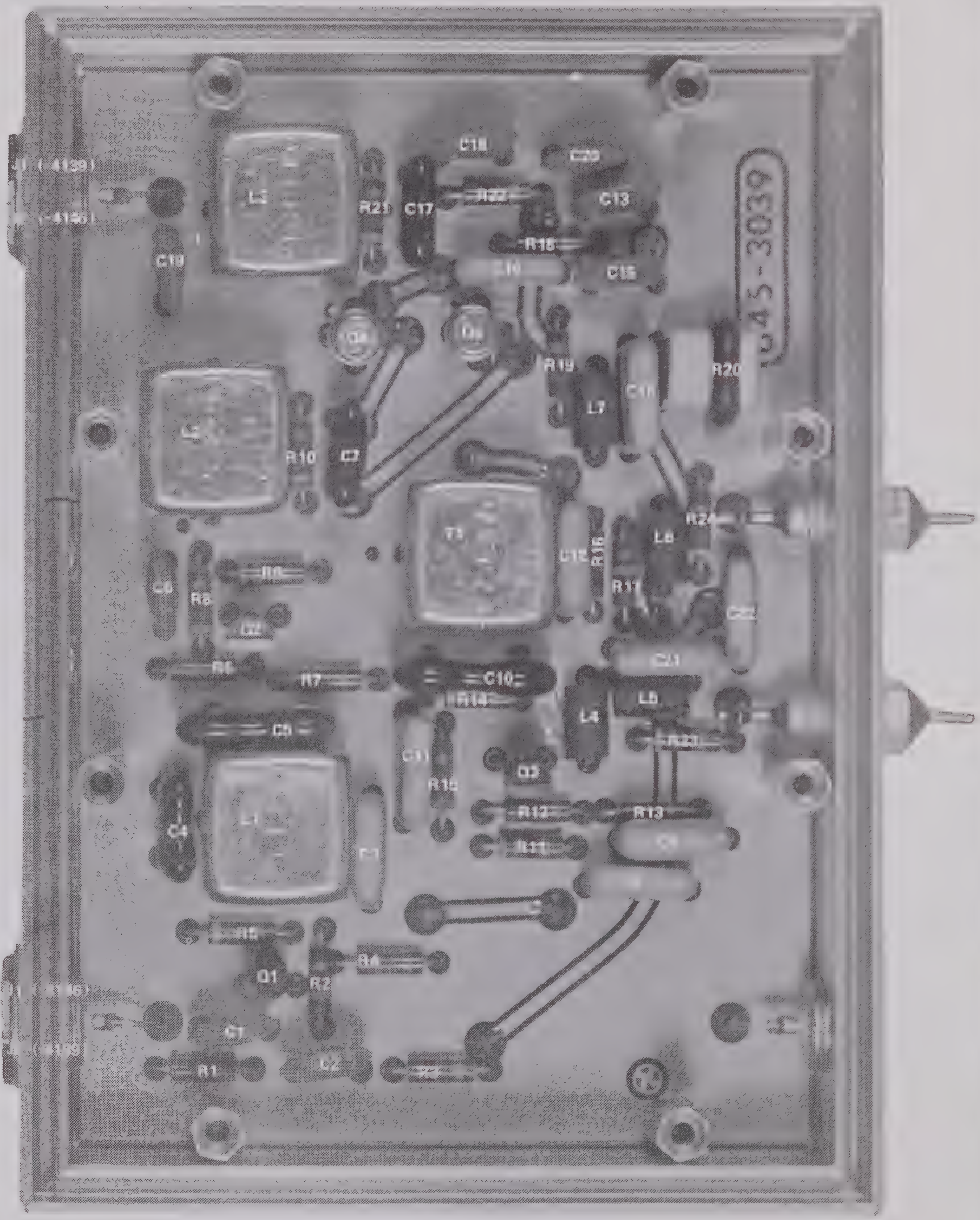
J1 (-4139)
J2 (-4146)
L3
R21
C17
C18
R22
C20
C13
R18
C16
C15
645-3039
C19
Q4
Q5
R19
R20
L7
C14
L2
R10
C7
T1
R24
L6
C12
R16
R17
C22
C6
R8
Q2
R6
R7
C10
R14
C21
L4
L5
R23
C5
C11
R15
Q3
C4
L1
R12
R13
R11
C9
R5
R4
Q1
R2
J1 (-4146)
C1
J2 (-4139)
R1
L2

Figure 5-18. DIGIT ADDER MIXER NO. 1 MODULE (645-4139), SEARCH MIXER MODULE (645-4146)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5, R10, R21	Res, comp, 4.7k ±5%, ¼w	148072	3		
R6	Res, comp, 8.2k ±5%, ¼w	160796	1		
R7, R18, R19	Res, comp, 2.7k ±5%, ¼w	170720	3		
R8, R11, R23, R24	Res, comp, 47Ω ±5%, ¼w	147892	4		
R9	Res, comp, 3.3k ±5%, ¼w	148056	1		
R14	Res, comp, 470Ω ±5%, ¼w	147983	1		
R15	Res, comp, 620Ω ±5%, ¼w	221903	1		
R17	Res, comp, 10k ±5%, ¼w	148106	1		
R20	Res, var, comp, 2k ±20%, ½w	208330	1		
R22	Res, comp, 100Ω ±5%, ¼w	147926	1		
T1	Transformer, var, nom, 3.4 uh	174276	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A18	**DIGIT ADDER MIXER NO. 2 MODULE (645-4141)** **Figure 5-19**	263434	REF		
A1	Digit Adder Mixer No. 2 PCB Assembly (See Figure 5-19)	264366	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265801	1		
	Cover, enclosure	253120	2		
	DIGIT ADDER MIXER NO. 2 PCB ASSEMBLY Figure 5-19	264366	REF		
C1 thru C4, C16, C20, C24	Cap, plstc, 0.047 uf ±10%, 250v	162008	7		
C7, C10, C12, C18, C19, C21, C22, C25 thru C28	Cap, cer, 0.0012 uf ±10%, 500v	106732	11		
C5	Cap, mica, 430 pf ±5%, 500v	177980	1		
C6	Cap, mica, 150 pf ±5%, 500v	148478	1		
C8, C13	Cap, mica, 12 pf ±5%, 500v	175224	2		
C9, C11	Cap, mica, 120 pf ±5%, 500v	148486	2		
C14, C15	Cap, mica, 390 pf ±5%, 500v	148437	2		
C17	Cap, mica, 68 pf ±5%, 500v	148510	1		
C23	Cap, mica, 100 pf ±5%, 500v	148494	1		
IC1	IC, differential/cascode amplifier	246256	1		
L1, L2, L8	Ferrite bead	219535	3		
L3	Inductor, var, nom, 4.2 uh	204958	1		
L4	Inductor, 22 uh, 590 ma	147843	1		
L5, L6	Inductor, RF, 4 turns, 25 MHz	255497	2		
L7	Inductor, var, nom, 0.25 uh	253294	1		
L9	Inductor, var, nom, 0.140 uh	253310	1		
Q1	Tstr, silicon, NPN	148593	1		
Q2	Tstr, Mos-FET, N-channel	267765	1		

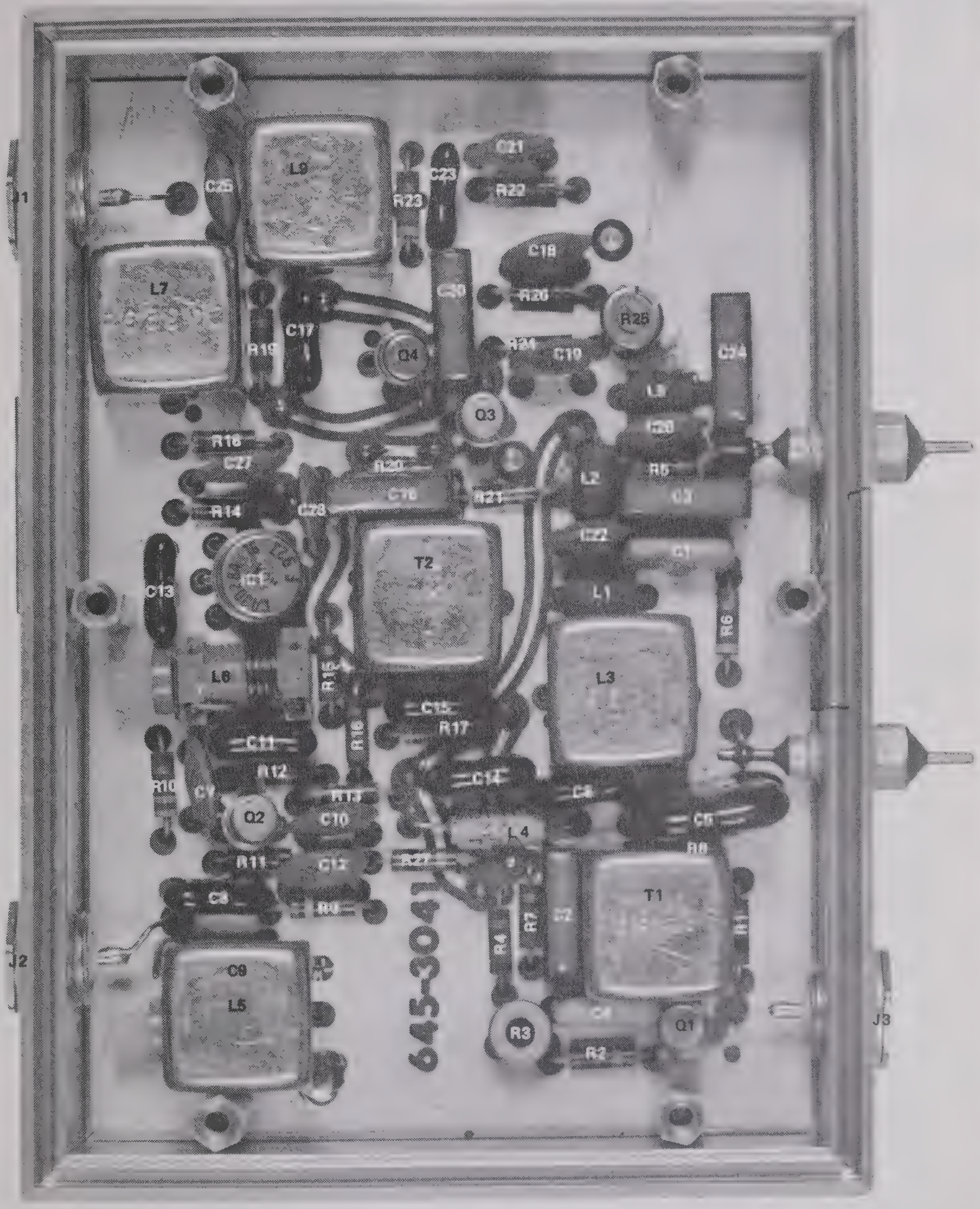
J1
C25
L9
C21
C23
R23
R22
L7
C18
R26
C17
R19
C30
R25
Q4
R24
C19
C24
L8
Q3
R18
C20
C27
R20
R5
L2
C16
R21
C3
R14
C28
C22
C1
T2
IC1
C13
L1
R6
L6
L3
R15
C15
R17
R16
C11
R12
C14
C6
R10
C7
R13
Q2
C10
C5
L4
R8
R11
C12
R27
C8
R9
T1
C2
R7
R4
R1
J2
C9
L5
645-3041
R3
C4
Q1
J3
R2

Figure 5-19. DIGIT ADDER MIXER NO. 2 MODULE (645-4141)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q3, Q4	Tstr, Mos-FET, N-channel	266411	2		
R1, R7, R14, R15, R22, R27	Res, comp, 100Ω ±5%, ¼w	147926	6		
R2	Res, comp, 10Ω ±5%, ¼w	147868	1		
R3	Res, var, cer met, 200Ω ±20%, ½w	226050	1		
R4, R19, R24, R26	Res, comp, 2.7k ±5%, ¼w	170720	4		
R5, R6	Res, comp, 47Ω ±5%, ¼w	147892	2		
R8, R17	Res, comp, 470Ω ±5%, ¼w	147983	2		
R9, R12	Res, comp, 3.9k ±5%, ¼w	148064	2		
R10, R13, R18	Res, comp, 3.3k ±5%, ¼w	148056	3		
R11, R21	Res, comp, 10k ±5%, ¼w	148106	2		
R16	Res, comp, 6.8k ±5%, ¼w	148098	1		
R20	Res, comp, 1.2k ±5%, ¼w	190371	1		
R23	Res, comp, 4.7k ±5%, ¼w	148072	1		
R25	Res, var, cer met, 2k ±20%, ½w	226076	1		
T1, T2	Transformer, var, nom, 5.4 uh	253369	2		
	Enclosure, L5	274829	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A19	**10/1 DIVIDER NO. 1 MODULE (645-4136-3)**	263384	REF		
A4A27	**10/1 DIVIDER NO. 1 MODULE (645-4136-2)**	270421	REF		
A4A31	**10/1 DIVIDER NO. 1 MODULE (645-4136-1)** **Figure 5-20**	270413	REF		
A1	10/1 Divider No. 1 PCB Assembly (see figure 5-20)	264333	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264929	1		
	Cover, enclosure	252916	2		
	10/1 DIVIDER NO. 1 PCB ASSEMBLY - Figure 5-20	264333	REF		
C1 thru C7, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	8		
C8	Cap, cer, 0.005 uf ±20%, 100v	175232	1		
C9, C10, C11	Cap, cer, 0.05 uf ±20%, 100v	149161	3		
C12, C14, C15	Cap, mica, 330 pf ±5%, 500v	148445	3		
C13	Cap, mica, 430 pf ±5%, 500v	177980	1		
CR1	Diode, silicon, 150 ma	203323	1		
IC1	IC, differential/cascode amplifier	246256	1		
IC2, IC3	IC, TTL, Dual J-K Flip Flop	267260	2		
L1, L3, L4, L7	Ferrite bead	219535	4		
L2	Inductor, 22 uh, 590 ma	147843	1		
L5, L6	Inductor, 10 uh, 480 ma	174730	2		
Q1, Q2	Tstr, silicon, NPN	248351	2		
Q3	Tstr, silicon, PNP	226290	1		
R1	Res, comp, 270Ω ±5%, ¼w	160804	1		
R2	Res, comp, 2.2k ±5%, ¼w	148049	1		
R3, R4, R7	Res, comp, 1k ±5%, ¼w	148023	3		
R5, R10	Res, comp, 470Ω ±5%, ¼w	147983	2		
R6	Res, comp, 47Ω ±5%, ¼w	147892	1		

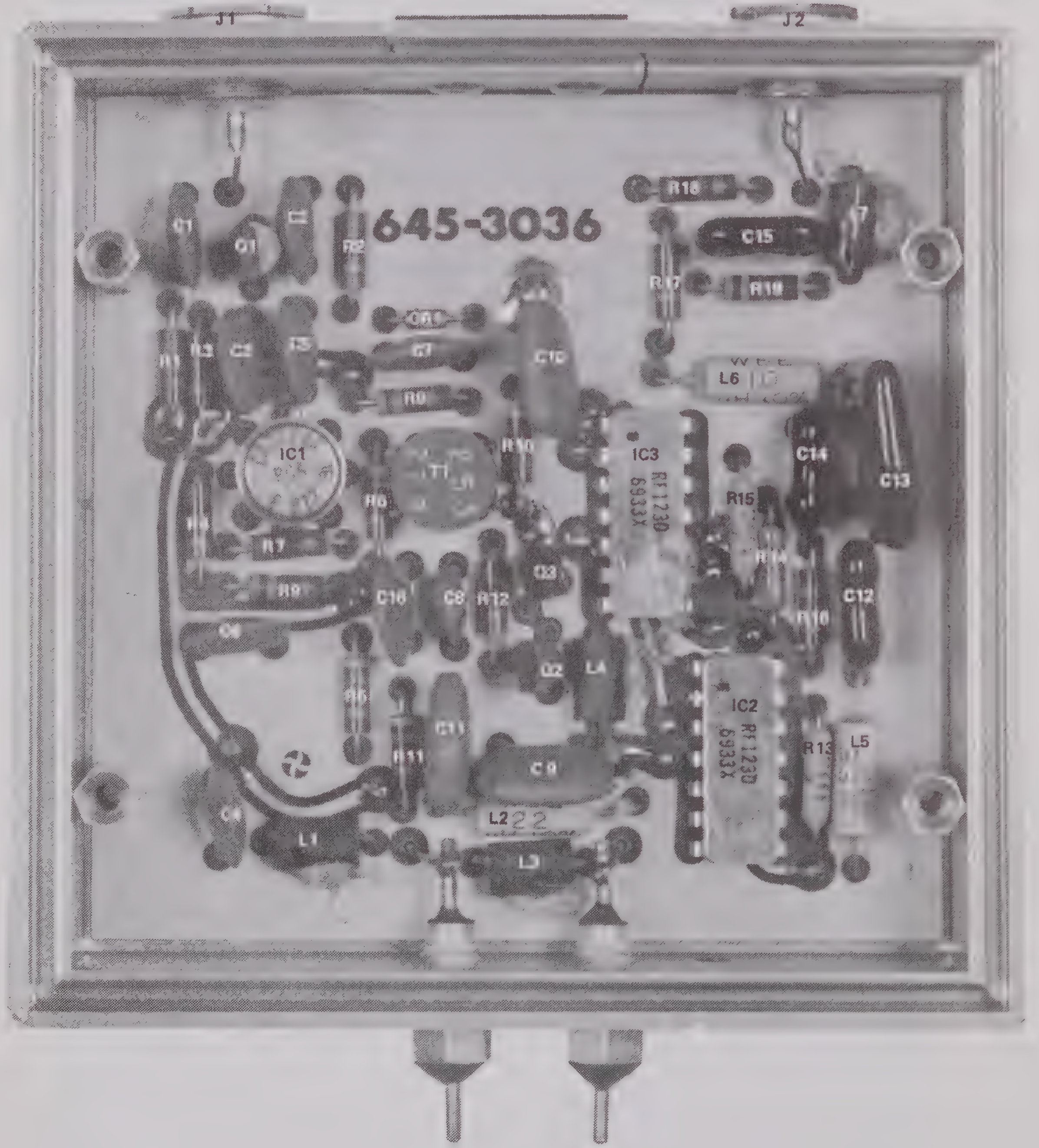
J1
J2
645-3036
Q1
C1
R2
R18
C15
R17
R19
CR1
C7
C10
L6
R1
R3
C2
R5
R9
IC1
T1
R10
IC3
RF123D
6933X
C14
C13
R6
R15
R7
R14
R9
C16
C8
R12
Q3
C12
R16
C6
Q2
L4
IC2
RF123D
6933X
C11
R11
R13
L5
C9
C4
L1
L2
L3

Figure 5-20. 10/1 DIVIDER NO. 1 MODULES (645-4136-1, -2, -3)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R8, R9	Res, comp, 3.3k ±5%, ¼w	148056	2		
R11	Res, comp, 4.7k ±5%, ¼w	148072	1		
R12, R16	Res, comp, 560Ω ±5%, ¼w	147991	2		
R13, R15	Res, met flm, 499Ω ±1%, 1/8w	168211	2		
R14	Res, met flm, 301Ω ±1%, 1/8w	267740	1		
R17	Res, comp, 22Ω ±5%, ¼w	147884	1		
R18	Res, comp, 100Ω ±5%, ¼w	147926	1		
R19	Res, comp, 3.3Ω ±5%, ¼w	182279	1		
T1	Transformer, var, nom, 2.5 uh	253278	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A20	**DIGIT ADDER MIXER FILTER NO.3 MODULE (645-4143)** **Figure 5-21**	263475	REF		
A1	Digit Adder Mixer Filter No.3 PCB Assembly (See Figure 5-21)	264382	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265793	1		
	Cover, enclosure	252965	2		
	DIGIT ADDER MIXER FILTER NO. 3 PCB ASSEMBLY Figure 5-21	264382	REF		
C1 thru C4, C6, C17, C18, C19	Cap, cer, 0.0012 uf ±10%, 500v	106732	8		
C5, C13	Cap, mica, 130 pf ±5%, 500v	266205	2		
C7, C9	Cap, mica, 100 pf ±5%, 500v	148494	2		
C8, C15	Cap, plstc, 0.047 uf ±10%, 250v	162008	2		
C10, C12	Cap, mica, 270 pf ± 5%, 500v	148452	2		
C11	Cap, cer, 6.8 pf ±0.25 pf, 500v	272518	1		
C14	Cap, mica, 330 pf ±5%, 500v	148445	1		
C16	Cap, mica, 12 pf ±5%, 500v	175224	1		
IC1, IC2	IC, differential/cascode amplifier	246256	2		
L1, L2, L3, L10, L11	Ferrite bead	219535	5		
L4, L7	Inductor, RF, 50 MHz	269027	2		
L5, L6, L8, L9	Inductor, RF, 4 turns, 25 MHz	255497	4		
Q1	Tstr, silicon, NPN	246264	1		
R1	Res, comp, 120Ω ±5%, 1/4w	170712	1		
R2	Res, comp, 680Ω ±5%, 1/4w	148007	1		
R3	Res, comp, 15Ω ±5%, 1/4w	147876	1		
R4, R7, R19	Res, comp, 3.3k ±5%, 1/4w	148056	3		

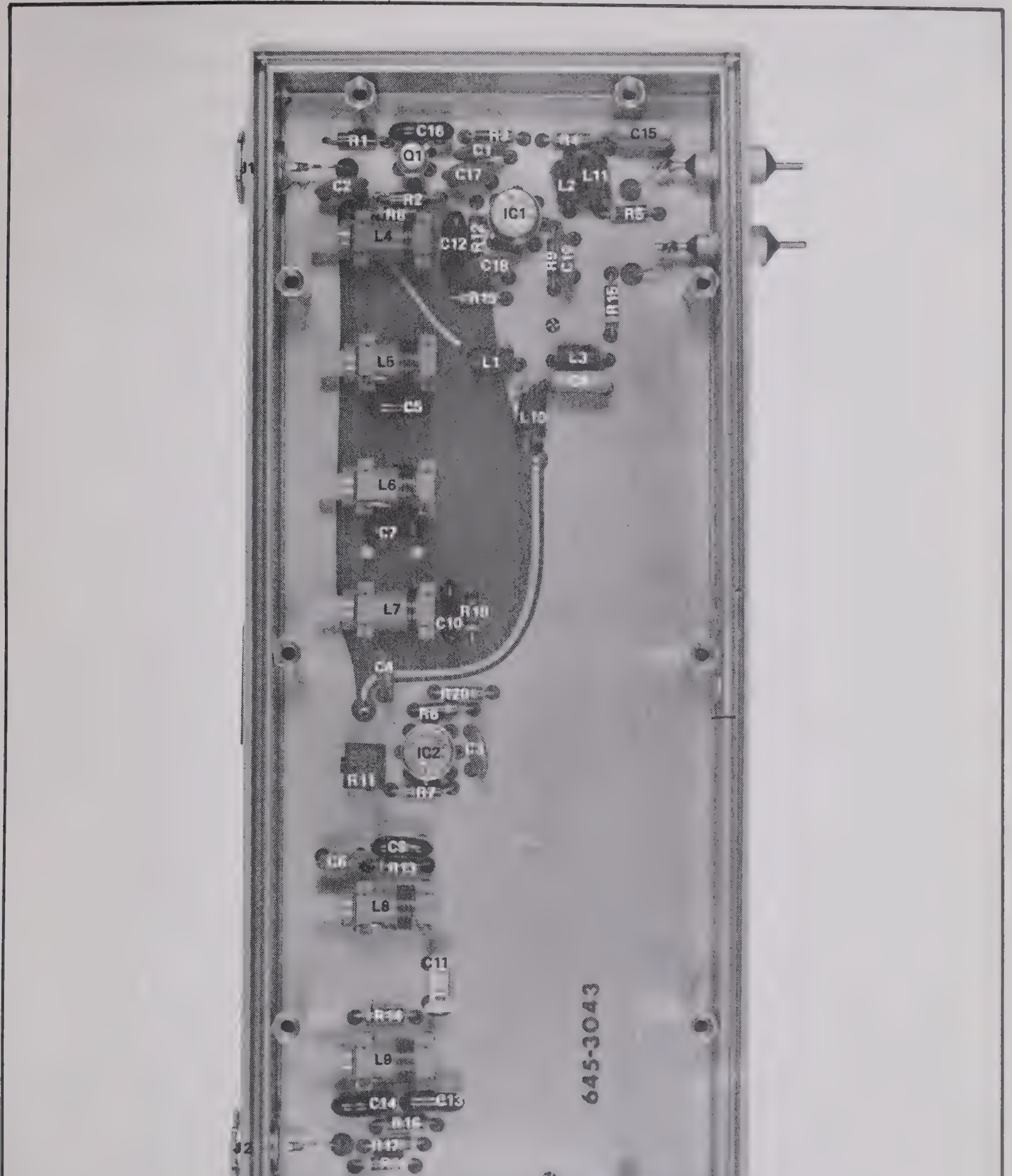
R1
C16
C15
J1
Q1
C1
C17
L2
L11
C2
R2
IC1
R5
L4
C12
C18
L5
L1
L3
C5
L10
L6
C7
L7
R10
C10
C4
R20
R6
IC2
R11
R7
C9
R13
L8
C11
R14
L9
C14
C13
R16
J2
R17
645-3043

Figure 5-21. DIGIT ADDER MIXER FILTER NO. 3 MODULE (645-4143)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5, R15, R18	Res, comp, 47Ω ±5%, 1/4w	147892	3		
R6, R12	Res, comp, 1.5k ±5%, 1/4w	148031	2		
R8, R10, R13, R14	Res, comp, 4.7k ±5%, 1/4w	148072	4		
R9	Res, comp, 2k ±5%, 1/4w	202879	1		
R11	Res, var, comp, 5k ±20%, 1/2w	241703	1		
R16, R17	Res, comp, 22Ω ±5%, 1/4w	147884	2		
R20	Res, comp, 6.8k ±5%, 1/4w	148098	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A21	**DIGIT ADDER FILTER/SEARCH OSCILLATOR FILTER MODULE (645-4129-6) -Figures 5-22 & 5-23**	263335	REF		
A1	Digit Adder Filter No. 1 PCB Assembly (See Figure 5-22)	264358	1		
A2	Search Oscillator Filter PCB Assembly (See Figure 5-23)	264424	1		
J1 thru J4	Connector, male, coaxial	207639	4		
	Cap, feed thru, 2500 pf gmv	248286	1		
L9	Ferrite bead	219535	1		
	Frame, enclosure	264911	2		
	Cover enclosure	252940	4		
	Plug, threaded	207084	2		
	DIGIT ADDER FILTER NO. 1 PCB ASSEMBLY Figure 5-22	264358	REF		
C1, C3, C5 C7, C9	Cap, mica, 18 pf ±5%, 500v	266585	5		
C2, C4, C6, C8	Cap, mica, 120 pf ±5%, 500v	148486	4		
L1 thru L4	Inductor, var, nom, 0.140 uh	253310	4		
	SEARCH OSCILLATOR FILTER PCB ASSEMBLY Figure 5-23	264424	REF		
C1, C3, C5, C7, C9, C15, C17	Cap, mica, 18 pf ±5%, 500v	266585	7		
C2, C4, C6, C8, C14 C16, C18	Cap, mica, 150 pf ±5%, 500v	148478	7		
C10, C11 C12, C13	Cap, cer, 0.005 uf ±20%, 50v	255471	4		
C19	Cap, cer, 0.0012 uf ±10%, 500v	106732	1		
L1 thru L7	Inductor, var, nom, 0.140 uh	253310	7		
Q1 thru Q3	Tstr, silicon, PNP	226290	3		
R1	Res, comp, 82Ω ±10%, 1/8w	266247	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2, R3	Res, comp, 6.8k ±10%, 1/8w	246967	2		
R4, R7, R8	Res, comp, 1.5k ±10%, 1/8w	153932	3		
R5	Res, comp, 27Ω ±10%, 1/8w	266254	1		
R6	Res, comp, 1k ±10%, 1/8w	153916	1		

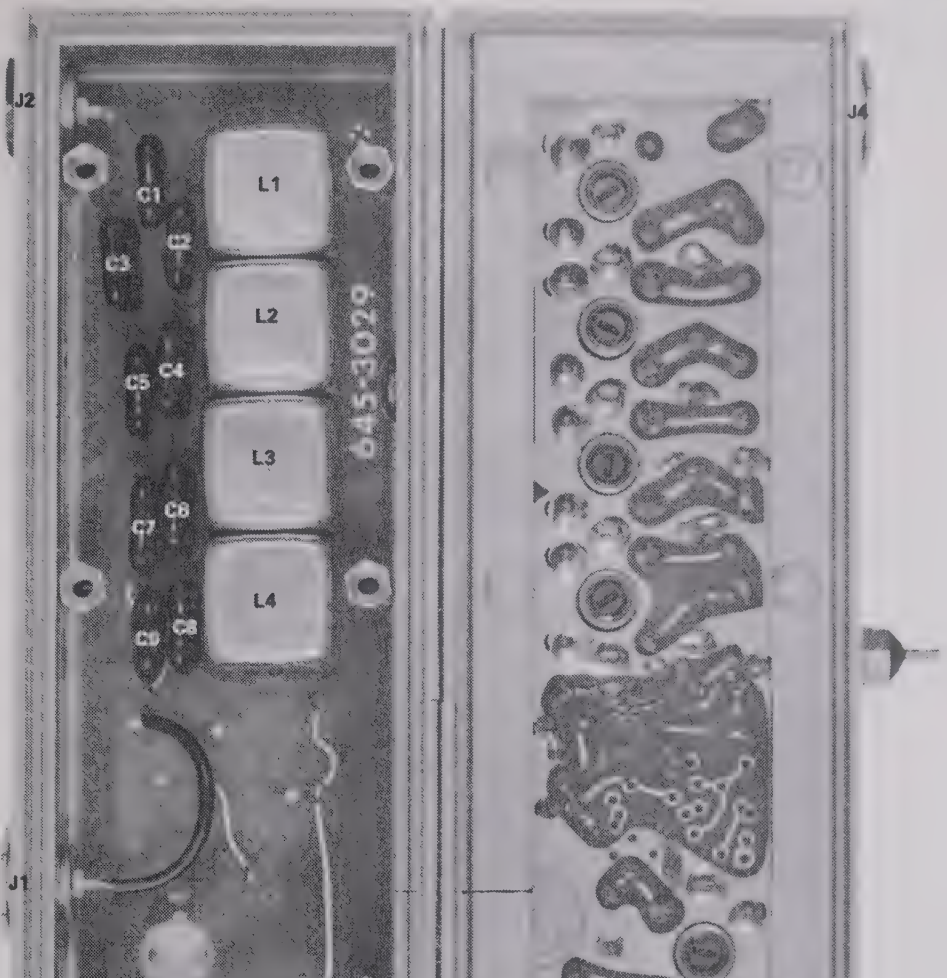
J2
C1
L1
C2
C3
L2
645-3029
C5
C4
L3
C6
C7
L4
C9
C8
J1
J4
J3

Figure 5-22. DIGIT ADDER FILTER NO. 1 PCB ASSEMBLY (645-4129-6)

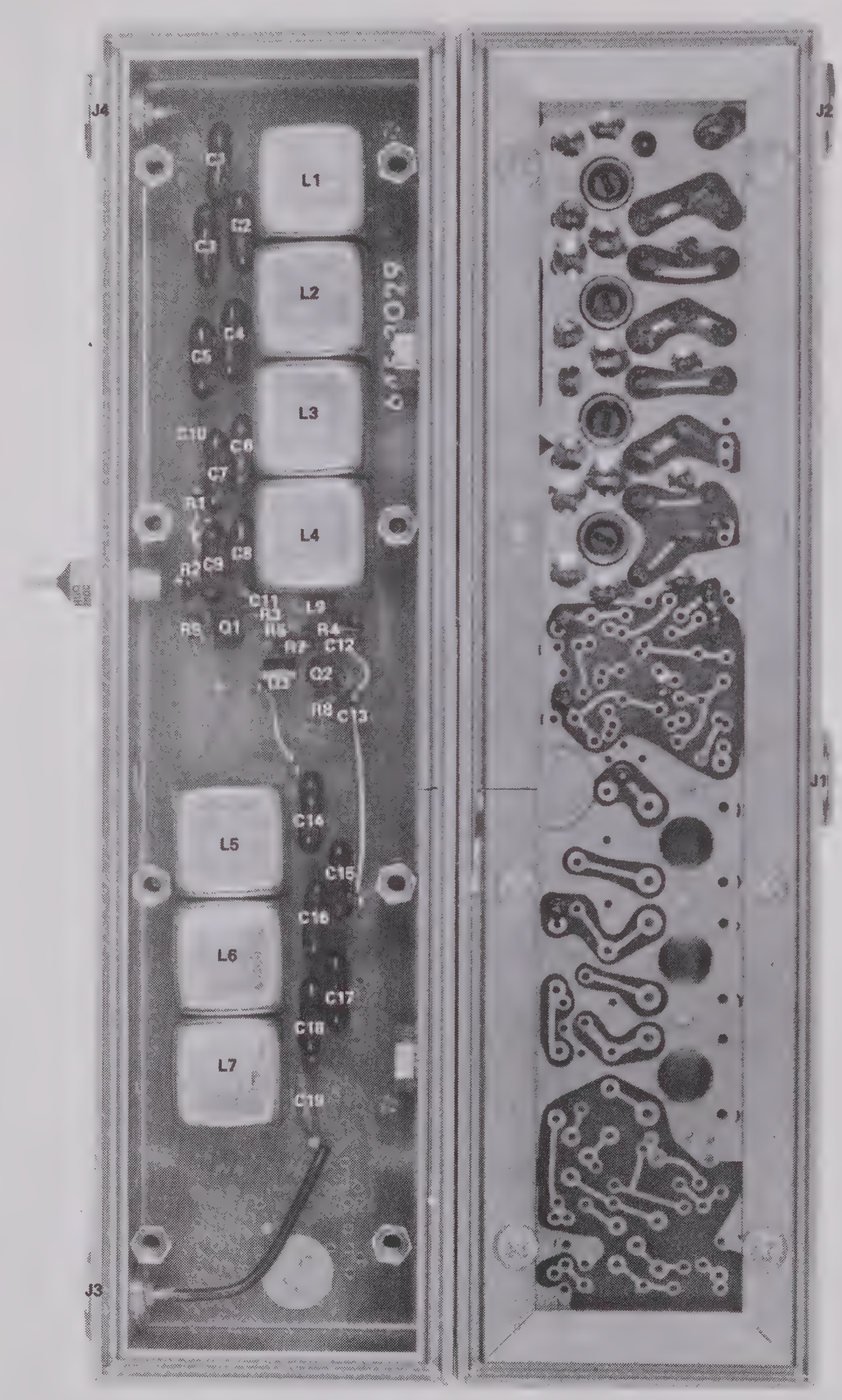
J4
C1
L1
C2
C3
L2
C4
C5
L3
C10
C6
C7
R1
L4
R2
C9
C8
C11
R3
L9
R5
Q1
R6
R4
R7
C12
Q2
R8
C13
C14
L5
C15
C16
L6
C17
C18
L7
C19
J3
J2
J1

Figure 5-23. SEARCH OSCILLATOR FILTER PCB ASSEMBLY (645-4129-6)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A22	**SEARCH MIXER MODULE (645-4146) - Figure 5-18**	263483	REF		
A1	Search Mixer PCB Assembly (See Figure 5-18)	264416	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264945	1		
	Cover, enclosure	252973	2		
	SEARCH MIXER PCB ASSEMBLY - Figure 5-18	264416	REF		
C1, C2, C6 C13, C15, C18, C19, C20	Cap, cer, 0.0012 uf ±10%, 500v	106732	8		
C3, C8, C9, C11, C12, C14, C16, C21, C22	Cap, plstc, 0.047 uf ±10%, 250v	162008	9		
C4, C7	Cap, mica, 120 pf ±5%, 500v	148486	2		
C5	Cap, mica, 680 pf ±1%, 500v	226159	1		
C10	Cap, mica, 1000 pf ±5%, 500v	148387	1		
C17	Cap, mica, 150 pf ±5%, 500v	148478	1		
L1, L2	Inductor, var, nom, 0.25 uh	253294	2		
L3	Inductor, var, nom, 0.140 uh	253310	1		
L4 thru L7	Ferrite bead	219535	4		
Q1, Q2	Tstr, silicon, NPN	248351	2		
Q3	Tstr, silicon, PNP	215897	1		
Q4, Q5	Tstr, Mos-FET, N-channel	266411	2		
R1	Res, comp, 120Ω ±5%, ¼w	170712	2		
R2	Res, comp, 56Ω ±5%, ¼w	147900	1		A
R2	Res, comp, 120Ω ±5%, ¼w	170712	REF		B
R3	Res, comp, 2k ±5%, ¼w	202879	1		
R4	Res, comp, 560Ω ±5%, ¼w	147991	1		
R5, R7, R18, R19	Res, comp, 2.7k ±5%, ¼w	170720	4		
R6	Res, comp, 8.2k ±5%, ¼w	160796	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R8	Res, comp, 47Ω ±5%, ¼w	147892	4		A
R8	Res, comp, 68Ω ±5%, ¼w	147918	1		B
R11, R23, R24	Res, comp, 47Ω ±5%, ¼w	147892	3		
R9	Res, comp, 3.3k ±5%, ¼w	148056	1		
R10	Res, comp, 4.7k ±5%, ¼w	148072	1		
R12, R13, R16	Res, comp, 1.2k ±5%, ¼w	190371	3		
R14	Res, comp, 430Ω ±5%, ¼w	203869	1		
R15	Res, comp, 620Ω ±5%, ¼w	221903	1		
R17	Res, comp, 10k ±5%, ¼w	148106	1		
R20	Res, var, comp, 2k ±30%, ½w	208330	1		
R21	Res, comp, 6.8k ±5%, ¼w	148098	1		
R22	Res, comp, 100Ω ±5%, ¼w	147926	1		
T1	Transformer, var, nom, 2.8 uh	265199	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A23	**SEARCH VCO MODULE (644-4124)**	254003	REF		
A1	Search VCO PCB Assembly (See Figure 5-24)	253658	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	3		
	Enclosure	255406	1		
	Cover	256560	1		
	Plug, threaded	207084	9		
	SEARCH VCO PCB ASSEMBLY - Figure 5-24	253658	REF		
C1, C4	Cap, Ta, 2.2 uf ±20%, 20v	161927	2		
C2, C3	Cap, mica, 2200 pf ±5%, 500v	148346	2		
C5, C11, C14	Cap, mica, 1000 pf ±5%, 500v	148387	3		
C6	Cap, Ta, 100 uf ±10%, 10v	170456	1		
C7	Cap, mica, 3300 pf ±5%, 500v	148320	1		
C8	Cap, var, air, 1-30 pf, 250v	248211	1		
C9	Cap, cer, 56 pf ±2%, 600v	249003	1		
C10	Cap, mica, 180 pf ±5%, 500v	148460	1		
C12, C13	Cap, plstc, 0.01 uf ±10%, 200v	168450	2		
C15, C17, C18	Cap, cer, 0.01 uf ±20%, 100v	149153	3		
C19, C22	Cap, mica, 390 pf ±5%, 500v	148437	2		
C20, C21	Cap, mica, 1500 pf ±5%, 500v	148361	2		
C23	Cap, cer, 0.0012 uf ±10%, 500v	106732	1		
C24	Cap, cer, 2700 pf, gmv, 600v	106211	1		
C25	Cap, plstc, 1200 pf ±10%, 200v	106088	1		
CR1 thru CR8, CR11, CR13	Diode, silicon, 150 ma	203323	10		
CR9, CR14	Diode, varactor/compensating, matched set	188920	1		
CR10	Diode, zener, 4.3v	180455	1		
CR12	Diode, zener, 6.3v, 7.5 ma	172148	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
L1, L2	Inductor, 470 uh, 180 ma	147827	2		
L3, L8	Inductor, 1000 uh, 140 ma	147819	2		
L4	Inductor, variable	240473	1		
L5, L7	Inductor, 3.3 uh, 1030 ma	174714	2		
L6	Inductor, 4.7 uh, 750 ma	174722	1		
Q1, Q2, Q3, Q9, Q10	Tstr, silicon, NPN	168708	5		
Q4, Q5, Q6	Tstr, silicon, PNP	215897	3		
Q7, Q8	Tstr, silicon, PNP	226290	2		
R1, R3, R5, R7, R9	Res, var, comp, 2k ±30%, ½w	208330	5		
R2, R6, R8, R10	Res, var, comp, 20k ±30%, ½w	203802	4		
R4	Res, var, comp, 50k ±30%, ½w	203810	1		
R11	Res, met flm, 93.1k ±1%, 1/8w	223586	1		
R13	Res, met flm, 56.2k ±1%, 1/8w	271346	1		
R14	Res, met flm, 3.83k ±1%, 1/8w	235143	1		
R15	Res, met flm, 3.57k ±1%, 1/8w	226217	1		
R16	Res, met flm, 90.9k ±1%, 1/8w	223537	1		
R17	Res, comp, 180k ±5%, ¼w	193441	1		
R18	Res, met flm, 866Ω ±1%, 1/8w	248641	1		
R19	Res, met flm, 32.4k ±1%, 1/8w	182956	1		
R20	Res, met flm, 68.1k ±1%, 1/8w	236828	1		
R21	Res, comp, 220k ±5%, ¼w	160937	1		
R22, R25	Res, met flm, 8.45k ±1%, 1/8w	221671	2		
R23	Res, met flm, 40.2k ±1%, 1/8w	235333	1		
R24	Res, comp, 330k ±5%, ¼w	192948	1		
R26	Res, met flm, 1.21k ±1%, 1/8w	229146	1		
R27	Res, met flm, 29.4k ±1%, 1/8w	235135	1		
R28	Res, comp, 820k ±5%, ¼w	220541	1		
R29	Res, met flm, 2.49k ±1%, 1/8w	226209	1		
R30, R37	Res, met flm, 1M ±1%, 1/8w	168229	2		

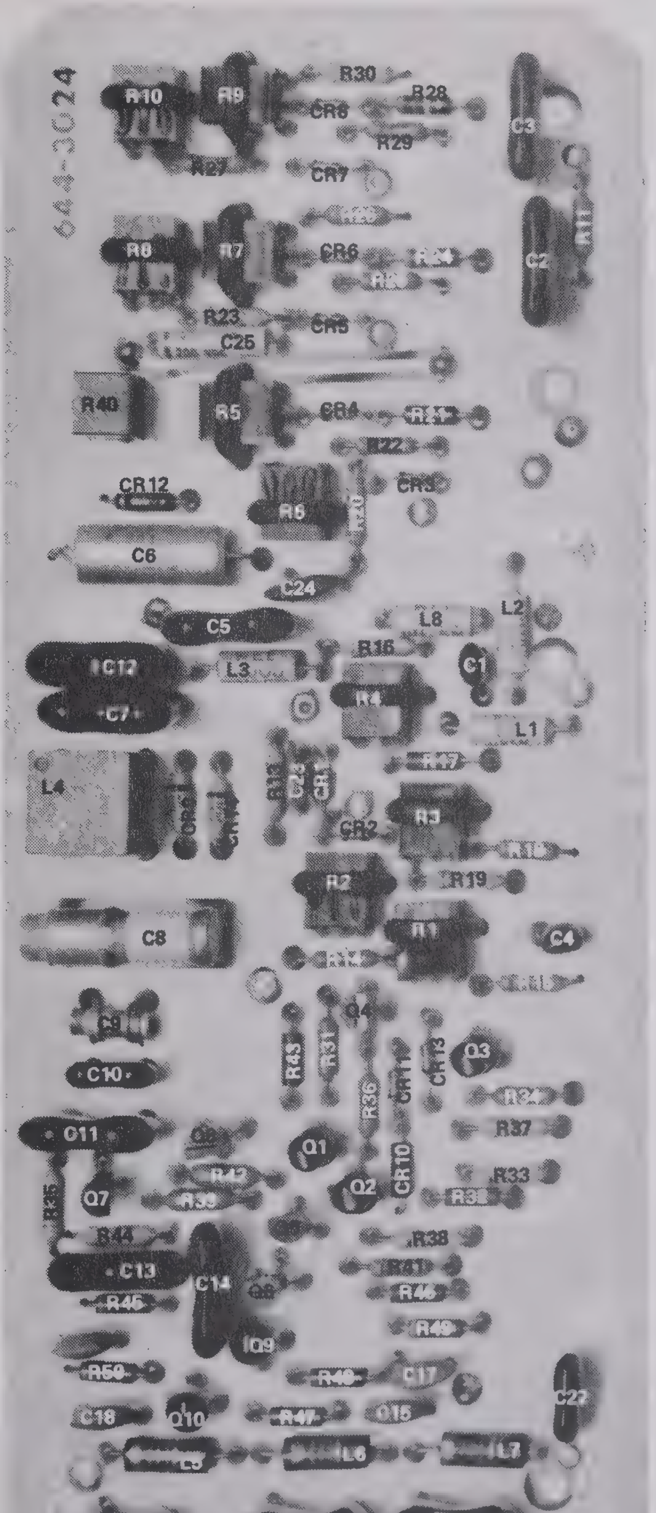
644-3024
R10
R9
R30
R28
CR8
C3
R29
R27
CR7
R11
R8
R7
CR6
C2
R23
CR5
C25
R40
R5
CR4
R22
CR12
R6
CR3
C6
C24
C5
L8
L2
R16
C12
L3
C1
C7
R4
L1
L4
R13
C23
CR1
R3
CR2
R2
R19
C8
R1
C4
C9
Q4
R43
R31
CR13
Q3
C10
R36
CR11
R24
R37
C11
Q1
R42
Q2
CR10
R33
Q7
R35
R39
R38
R44
C13
R41
C14
R46
R45
R49
Q9
R50
R48
C17
C22
C18
Q10
R47
L5
L6
L7
C19
C20
C21

Figure 5-24. SEARCH VCO P/C ASSEMBLY (644-4124)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R31, R32, R36, R38, R41	Res, met flm, 4.22k ±1%, 1/8w	168245	5		
R33, R43	Res, comp, 2.7k ±5%, ¼w	170720	2		
R34	Res, met flm, 100Ω ±1%, 1/8w	168195	1		
R35, R44	Res, met flm, 10k ±1%, 1/8w	168260	2		
R39, R42	Res, met flm, 499Ω ±1%, 1/8w	168211	2		
R40	Res, var, cer met, 2k ±10%, ½w	255489	1		
R45	Res, comp, 4.7k ±5%, ¼w	148072	1		
R46, R48	Res, comp, 1k ±5%, ¼w	148023	2		
R47	Res, comp, 56Ω ±5%, ¼w	147900	1		
R49	Res, comp, 470Ω ±5%, ¼w	147983	1		
R50	Res, comp, 47Ω ±5%, ¼w	147892	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A24	**DIGIT SHIFT MIXER NO. 2 MODULE (645-4138-2)**	275008	REF		
A4A28	**DIGIT SHIFT MIXER NO. 2 MODULE (645-4138-1)** **Figure 5-25**	263400	REF		
A1	Digit Shift Mixer No. 2 PCB Assembly (See Figure 5-25)	252593	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265819	1		
	Cover, enclosure	252973	2		
	DIGIT SHIFT MIXER NO. 2 PCB ASSEMBLY Figure 5-25	252593	REF		
C1	Cap, mica, 220 pf ±5%, 500v	170423	1		
C2, C3, C10, C11, C15, C25, C26	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C4, C22	Cap, mica, 68 pf ±1%, 500v	266593	2		
C5, C6, C23	Cap, mica, 150 pf ±5%, 500v	148478	3		
C7, C8, C9, C12 C13, C24	Cap, plstc, 0.047 uf ±10%, 250v	162008	6		
C14, C20	Cap, mica, 82 pf ±5%, 500v	148502	2		
C17, C19	Cap, mica, 5 pf ±10%, 500v	148577	2		
C18	Cap, mica, 100 pf ±5%, 500v	148494	1		
C21	Cap, mica, 10 pf ±10%, 500v	175216	1		
L1	Inductor, var, nom, 0.25 uh	253294	1		
L2 thru L6	Ferrite bead	219535	5		
L7	Inductor, 10 uh, 480 ma	174730	1		
L8, L9, L10	Inductor, var, nom, 0.16 uh	253286	3		
L11	Inductor, var, nom, 0.35 uh	253302	1		
Q1, Q4	Tstr, silicon, NPN	248351	2		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1, R2, R5	Res, comp, 47Ω ±5%, ¼w	147892	3		
R3, R18	Res, comp, 2.7k ±5%, ¼w	170720	2		

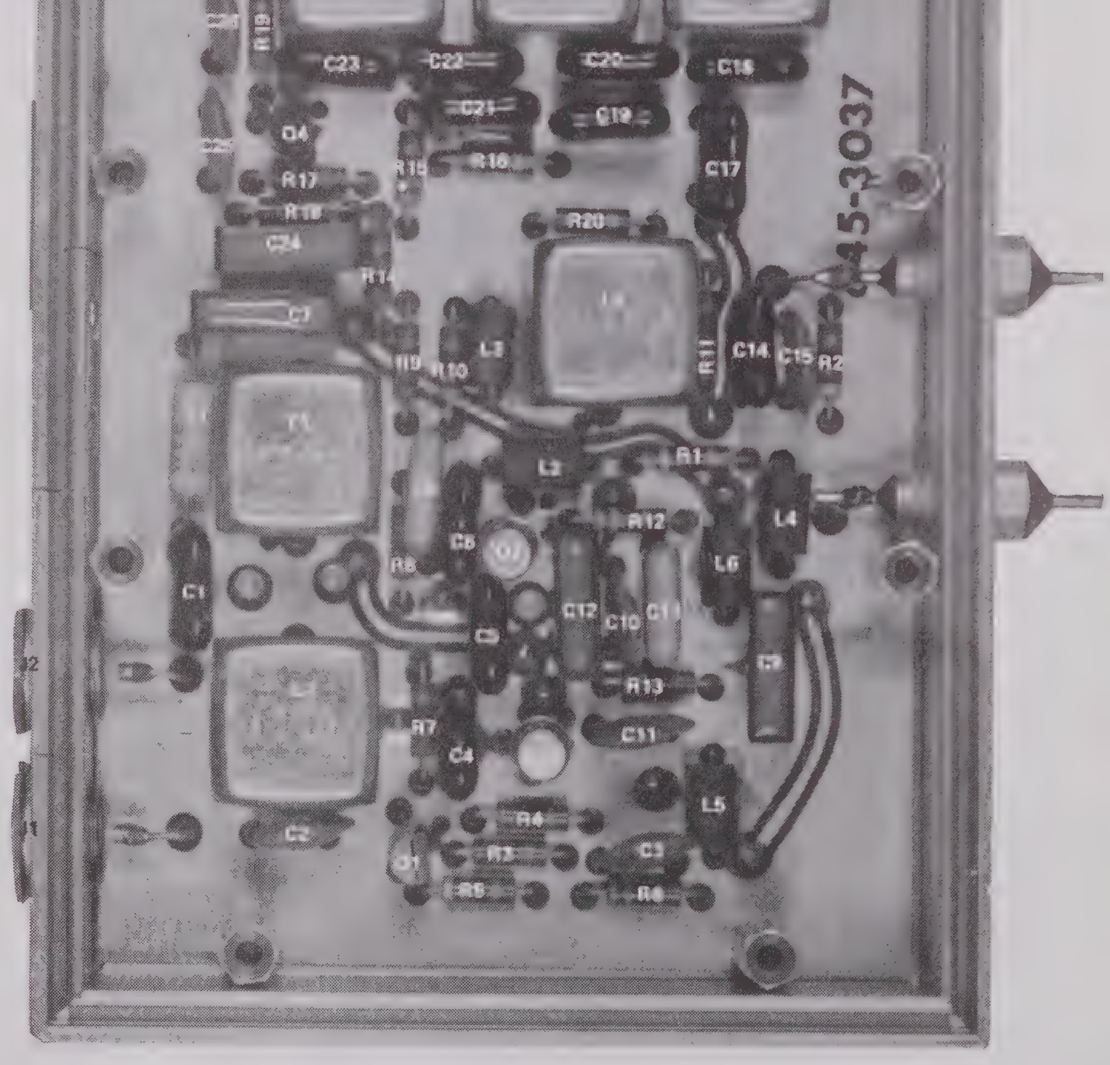
J3
R19
C23
C22
C20
C18
C21
C19
Q4
R17
R15
R16
C17
645-3037
R18
R20
C24
R14
C7
L3
R9
R10
R11
C14
C15
R2
T1
L2
R1
R12
L4
C6
Q2
R8
L6
C1
C12
C10
C11
C5
J2
C9
R13
R7
C4
L5
R4
J1
C2
R3
C3
Q1
R5
R6

Figure 5-25. DIGIT SHIFT MIXER NO. 1 MODULES (645-4137-1, -2), DIGIT SHIFT MIXER NO. 2 MODULES (645-4138-1, -2)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R4	Res, comp, 8.2k ±5%, ¼w	160796	1		
R6, R12, R13, R15	Res, comp, 3.3k ±5%, ¼w	148056	4		
R7	Res, comp, 6.8k ±5%, ¼w	148098	1		
R8, R9	Res, comp, 680Ω ±5%, ¼w	148007	2		
R10	Res, comp, 4.7k ±5%, ¼w	148072	1		
R11	Res, comp, 1.5k ±5%, ¼w	148031	1		
R14, R20	Res, comp, 100Ω ±5%, ¼w	147926	2		
R16	Res, comp, 1k ±5%, ¼w	148023	1		
R17	Res, comp, 27Ω ±5%, ¼w	160812	1		
R19	Res, comp, 68Ω ±5%, ¼w	147918	1		
T1	Transformer, var, nom, 35 uh	173773	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A25	**10/1 DIVIDER NO. 2 MODULE (645-4149-2)**	275016	REF		
A4A29	**10/1 DIVIDER NO. 2 MODULE (645-4149-1)** **Figure 5-26**	263517	REF		
A1	10/1 Divider No. 2 PCB Assembly (See Figure 5-26)	264440	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264929	1		
	Cover, enclosure	252916	2		
	10/1 DIVIDER NO. 2 PCB ASSEMBLY Figure 5-26	264440	REF		
C1, C2, C3, C6, C7, C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	6		
C4, C12, C14	Cap, mica, 82 pf ±5%, 500v	148502	3		
C5	Cap, mica, 10 pf ±10%, 500v	175216	1		
C8	Cap, mica, 100 pf ±5%, 500v	148494	1		
C9, C10, C11	Cap, cer, 0.05 uf ±20%, 100v	149161	3		
C13	Cap, mica, 430 pf ±5%, 500v	177980	1		
C15	Cap, mica, 39 pf ±5%, 500v	148544	1		
CR1	Diode, silicon, 150 ma	203323	1		
IC1	IC, differential/cascode amplifier	246256	1		
IC2, IC3	IC, TTL, Dual J-K Flip Flop	267260	2		
L1, L3, L4	Ferrite bead	219535	3		
L2, L9, L10	Inductor, 10 uh, 432 ma	249078	3		
L5, L6	Inductor, 22 uh, 590 ma	147843	2		
L7, L8	Inductor, var, nom, 0.16 uh	253286	2		
Q1	Tstr, silicon, NPN	248351	1		
R1	Res, comp, 3.3k ±5%, ¼w	148056	1		
R2, R4	Res, comp, 2.7k ±5%, ¼w	170720	2		
R3, R9, R18	Res, comp, 100Ω ±5%, ¼w	147926	3		

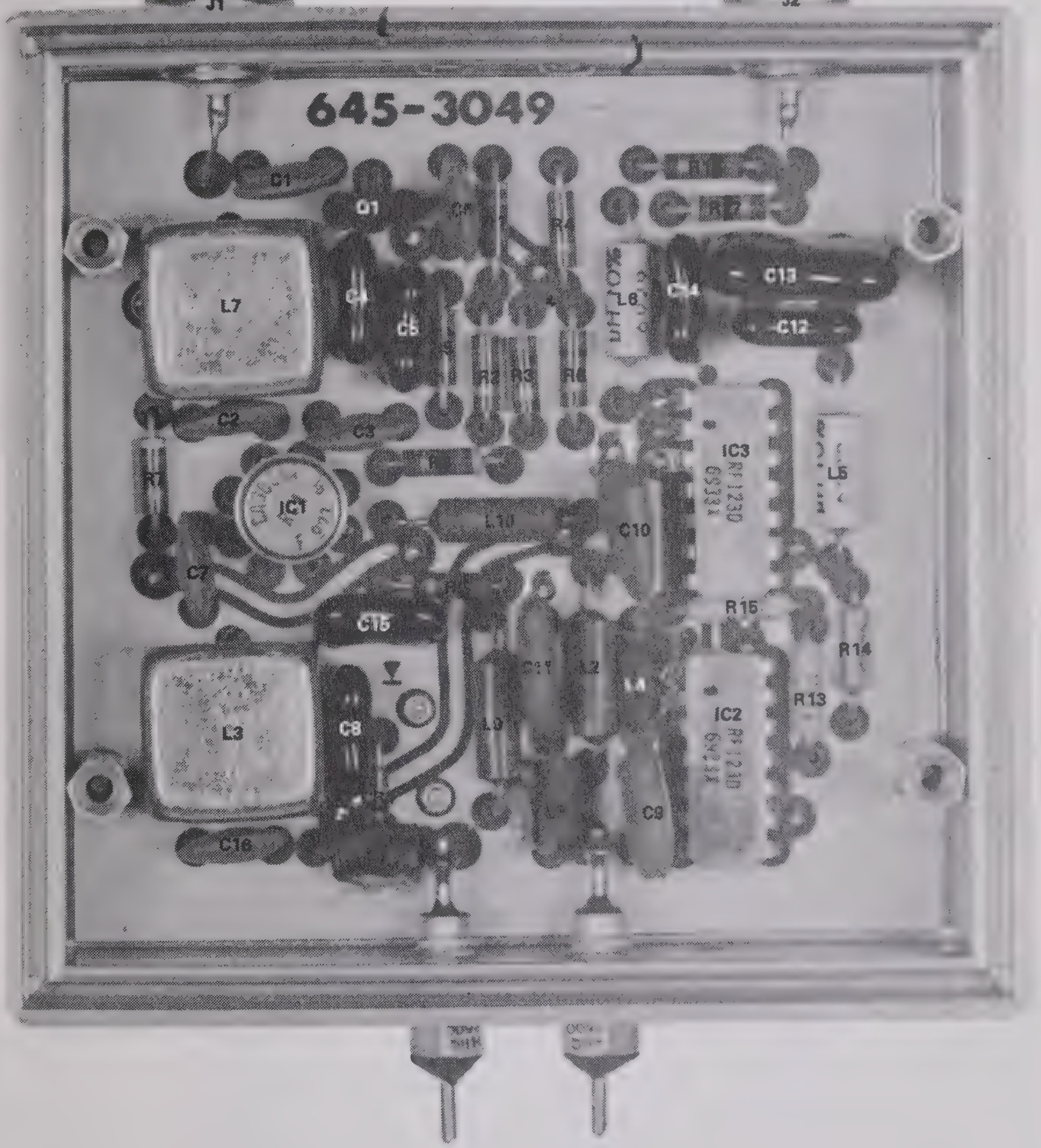
J1
J2
645-3049
C1
Q1
R4
R11
R12
L7
C4
C5
L6
C14
C13
C12
R2
R3
R6
C2
C3
IC3
L5
R7
IC1
L10
C10
C7
R15
C15
R14
R13
IC2
L3
C8
L9
C11
C9
C16

Figure 5-26. 10/1 DIVIDER NO. 2 MODULES (645-4149-1, -2)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5, R6	Res, comp, 1k ±5%, ¼w	148023	2		
R7	Res, comp, 470Ω ±5%, ¼w	147983	1		
R8, R17	Res, comp, 47Ω ±5%, ¼w	147892	2		
R13, R15	Res, met flm, 499Ω ±1%, 1/8w	168211	2		
R14	Res, met flm, 301Ω ±1%, 1/8w	267740	1		
	Socket, I.C. (used with I.C. 2)	276527	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A26	**DIGIT SHIFT MIXER NO. 1 MODULE (645-4137-1)**	263392	REF		
A4A30	**DIGIT SHIFT MIXER NO. 1 MODULE (645-4137-2)** **Figure 5-25**	274993	REF		
A1	Digit Shift Mixer No. 1 PCB Assembly (See Figure 5-25)	252585	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265819	1		
	Cover, enclosure	252973	2		
	DIGIT SHIFT MIXER NO. 1 PCB ASSEMBLY Figure 5-25	252585	REF		
C1	Cap, mica, 68 pf ±5%, 500v	148510	1		
C2, C3, C10, C11, C15, C25, C26	Cap, cer, 0.0012 uf ±10%, 500v	106732	7		
C4, C22	Cap, mica, 82 pf ±1%, 500v	271957	2		
C5, C6, C14	Cap, mica, 100 pf ±5%, 500v	148494	3		
C7, C8, C9, C12, C13, C24	Cap, plstc, 0.047 uf ±10%, 250v	162008	6		
C17, C19	Cap, mica, 4 pf ±5%, 500v	190397	2		
C18, C20	Cap, mica, 120 pf ±5%, 500v	148486	2		
C21	Cap, mica, 8 pf ±10%, 500v	216986	1		
C23	Cap, mica, 180 pf ±5%, 500v	148460	1		
L1	Inductor, var, nom, 0.25 uh	253294	1		
L2 thru L6	Ferrite bead	219535	5		
L7	Inductor, 22 uh, 590 ma	147843	1		
L8, L9, L10	Inductor, var, nom, 0.16 uh	253286	3		
L11	Inductor, var, nom, 0.35 uh	253302	1		
Q1, Q4	Tstr, silicon, NPN	248351	2		
Q2, Q3	Tstr, Mos-FET, N-channel	266411	2		
R1, R2, R5	Res, comp, 47Ω ±5%, ¼w	147892	3		
R3, R18	Res, comp, 2.7k ±5%, ¼w	170720	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R4	Res, comp, 8.2k ±5%, ¼w	160796	1		
R6, R11, R12, R13, R15	Res, comp, 3.3k ±5%, ¼w	148056	5		
R7	Res, comp, 6.8k ±5%, ¼w	148098	1		
R8, R9	Res, comp, 680Ω ±5%, ¼w	148007	2		
R10	Res, comp, 4.7k ±5%, ¼w	148072	1		
R14, R20	Res, comp, 100Ω ±5%, ¼w	147926	2		
R16	Res, comp, 1k ±5%, ¼w	148023	1		
R17	Res, comp, 27Ω ±5%, ¼w	160812	1		
R19	Res, comp, 68Ω ±5%, ¼w	147918	1		
T1	Transformer, var, nom, 35 uh	173773	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A32 A4A33 A4A34 A4A35 A4A36	**DIGIT SHIFT MIXER MODULE (645-4135)** **Figure 5-27**	263376	REF		
A1	Digit Shift Mixer PCB Assembly (See Figure 5-27)	264325	1		
J1 thru J4	Connector, male, coaxial	207639	4		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	264937	1		
	Cover, enclosure	252965	2		
	DIGIT SHIFT MIXER PCB ASSEMBLY - Figure 5-27	264325	REF		
C1, C42, C44	Cap, mica, 82 pf ±5%, 500v	148502	3		
C2, C13	Cap, mica, 120 pf ±5%, 500v	148486	2		
C3, C24	Cap, mica, 22 pf ±5%, 500v	148551	2		
C4, C5	Cap, mica, 430 pf ±5%, 500v	177980	2		
C6	Cap, mica, 270 pf ±5%, 500v	148452	1		
C7, C8, C9, C11, C14 thru C20, C27, C29, C33, C34, C35, C37	Cap, cer, 0.0012 uf ±10%, 500v	106732	17		
C10	Cap, mica, 68 pf ±5%, 500v	148510	1		
C12	Cap, mica, 5 pf ±10%, 500v	148577	1		
C21, C22, C39, C41	Cap, cer, 0.05 uf ±20%, 100v	149161	4		
C23, C40	Cap, mica, 2 pf ±0.5 pf, 500v	175208	2		
C25, C26	Cap, mica, 150 pf ±5%, 500v	148478	2		
C28	Cap, mica, 56 pf ±5%, 500v	148528	1		
C30	Cap, mica, 15 pf ±5%, 500v	148569	1		
C31	Cap, mica, 68 pf ±1%, 500v	266593	1		
C32	Cap, mica, 150 pf ±1%, 500v	226134	1		
C36	Cap, mica, 27 pf ±5%, 500v	177998	1		

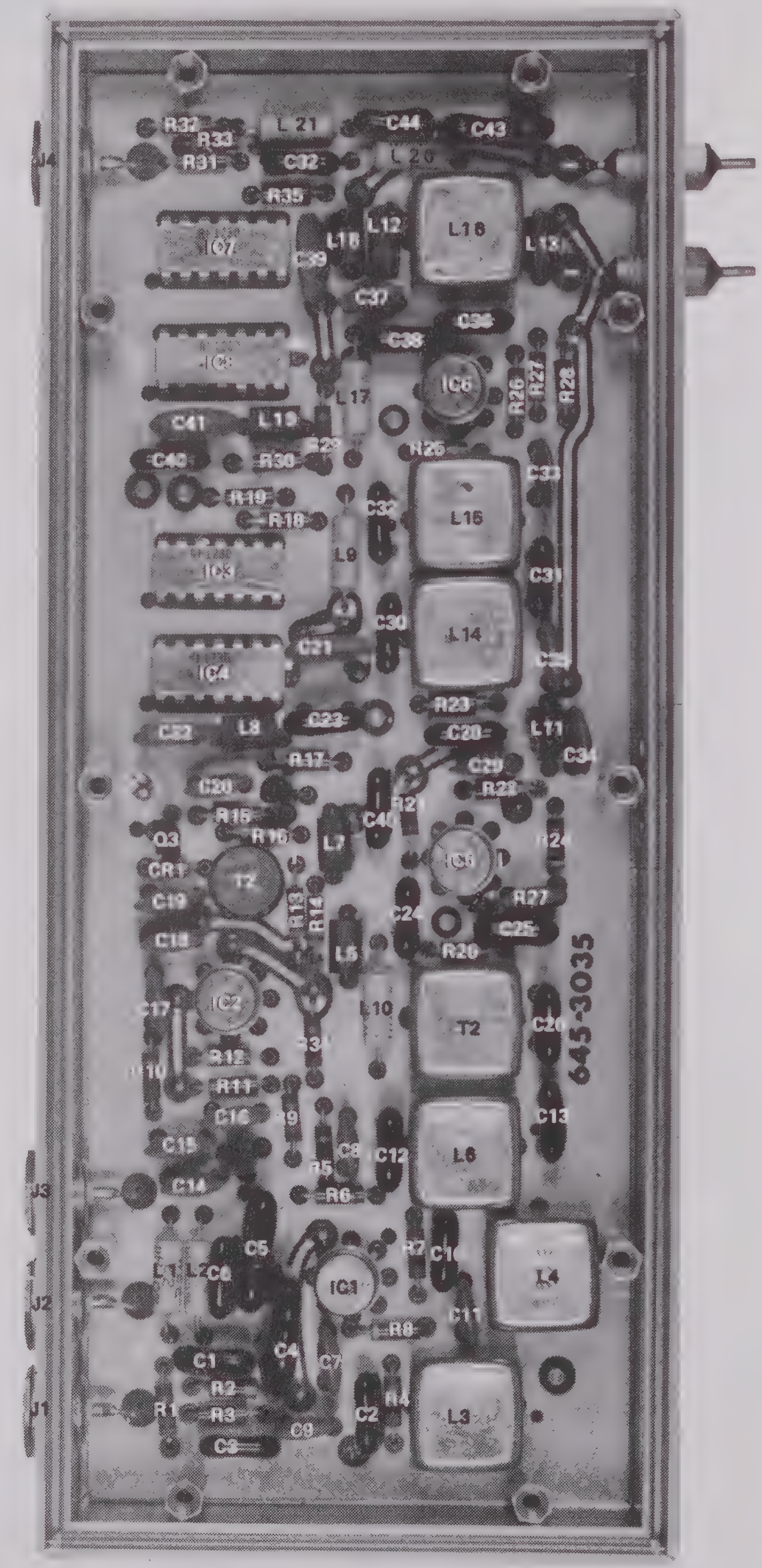
R32
L21
C44
C43
R33
J4
R31
C32
L20
R35
L16
L12
L18
L13
IC7
C39
C37
C36
C38
IC8
L17
IC6
R26
R27
R28
C41
L19
R29
R25
C40
R30
C33
R19
R18
C32
L15
L9
IC3
C31
C30
L14
C21
IC4
R23
C22
L8
C23
C20
L11
C34
R17
C29
C20
R22
R21
R15
C40
R16
R24
Q3
L7
IC5
CR1
T2
R13
R14
R27
C19
C24
C25
C18
L5
R20
645-3035
C17
IC2
L10
T2
C20
R34
R12
R10
R11
C16
R9
C13
C15
C8
C12
L6
R5
J3
C14
R6
C5
R7
C10
L1
L2
C6
L4
J2
IC1
R8
C11
C1
C4
C7
R2
C2
R4
J1
R1
R3
C9
L3
C3

Figure 5-27. DIGIT SHIFT MIXER MODULES (645-4135)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
C38	Cap, mica, 39 pf ±5%, 500v	148544	1		
C43	Cap, mica, 470 pf ±5%, 500v	148429	1		
C45	Cap, mica, 220 pf ±5%, 500v	170423	1		
CR1	Diode, silicon, 150 ma	203323	1		
IC1, IC2, IC5, IC6	IC, differential/cascode amplifier	246256	4		
IC3, IC4, IC7, IC8	IC, TTL, Dual J-K Flip Flop	267260	4		
L1, L9, L20, L21	Inductor, 22 uh, 590 ma	147843	4		
L2	Inductor, 3.3 uh, 1030 ma	174714	1		
L3, L6	Inductor, var, nom, 0.16 uh	253286	2		
L4, L14	Inductor, var, nom, 0.25 uh	253294	2		
L5, L7, L8, L11, L12, L13, L18, L19	Ferrite bead	219535	8		
L10, L17	Inductor, 10 uh, 480 ma	174730	2		
L15, L16	Inductor, var, nom, 0.35 uh	253302	2		
Q1, Q2	Tstr, silicon, NPN	248351	2		
Q3	Tstr, silicon, PNP	226290	1		
R1, R2, R33	Res, comp, 68Ω ±5%, ¼w	147918	3		
R3, R6, R22	Res, comp, 220Ω ±5%, ¼w	147959	3		
R4, R7	Res, comp, 10k ±5%, ¼w	148106	2		
R5, R8, R21, R24	Res, comp, 4.7k ±5%, ¼w	148072	4		
R9, R30, R32	Res, comp, 270Ω ±5%, ¼w	160804	3		
R10, R23	Res, comp, 2.2k ±5%, ¼w	148049	2		
R11, R18, R25, R34	Res, comp, 1k ±5%, ¼w	148023	4		
R12, R26	Res, comp, 470Ω ±5%, ¼w	147983	2		
R13, R14, R27, R28	Res, comp, 3.3k ±5%, ¼w	148056	4		
R15	Res, comp, 330Ω ±5%, ¼w	147967	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R16	Res, comp, 560Ω ±5%, ¼w	147991	1		
R17, R20	Res, comp, 1.5k ±5%, ¼w	148031	2		
R19	Res, comp, 56Ω ±5%, ¼w	147900	1		
R29	Res, comp, 680Ω ±5%, ¼w	148007	1		
R31	Res, comp, 120Ω ±5%, ¼w	170712	1		
R35	Res, comp, 100Ω ±5%, ¼w	147926	1		
T1	Transformer, var, nom, 2.5 uh	253278	1		
T2	Transformer, var, nom, 35 uh	173773	1		
	Socket, I.C. (used with I.C. 3, I.C. 7)	296527	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4A37	**3 MHz BUS BLOCK ASSEMBLY (645-4235)**	273904	REF		
	Connector, female, coaxial	215301	3		
	RF Cable No. 12	270280	1		
	RF Cable No. 41	270116	1		
A4A38	**4 MHz BUS BLOCK ASSEMBLY (645-4236)**	273912	REF		
	Connector, female, coaxial	215301	3		
	Res, comp, 100Ω ±5%, ¼w	147926	1		
	RF Cable No. 13	270306	1		
	RF Cable No. 40	270116	1		
	RF Cable No 54	270314	1		
A4A39	**30 MHz BUS BLOCK ASSEMBLY (645-4237)**	273920	REF		
	Connector, female, coaxial	215301	2		
	RF Cable, No. 11	270280	1		
	RF Cable No. 44	270223	1		
	RF Cable No. 45	270256	1		
A4A40	**35 MHz BUS BLOCK ASSEMBLY (645-4238)**	273938	REF		
	Connector, female, coaxial	215301	3		
	RF Cable No. 16	270272	1		
	RF Cable No. 42	270199	1		
	RF Cable No. 43	270264	1		
A4A41	**40 MHz BUS BLOCK ASSEMBLY (645-4239)**	273946	REF		
	Connector, female, coaxial	215301	2		
	RF Cable No. 10	270249	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5	**UHF TRAY ASSEMBLY - Figure 5-28**	263798	REF		
A1	Oscillator Module (645-4185) (See Figure 5-29)	263657	1	1	
A2	AGC Amplifier Module (645-4192) (See Figure 5-30)	263723	1	1	
A3	390 MHz 3-Stage Amplifier Module (645-4186) (See Figure 5-31)	263665	1	1	
A4	340 MHz 3-Stage Amplifier Module (645-4188) (See Figure 5-31)	263681	1	1	
A5	Input Mixer Module (645-4187) (See Figure 5-32)	263673	1	1	
A6	340 MHz Filter, UHF, passband	268748	1		
A7	380 MHz Filter, UHF, passband	268755	1		
A8	First Up Converter Module (645-4189) (See Figure 5-33)	263699	1	1	
A9	380 MHz 3 Stage Amplifier Module (645-4195) (See Figure 5-31)	269936	1	1	
A10	Amplitude Control Module (645-4194) (See Figure 5-34)	263749	1	1	
A11	415 MHz 3-Stage Amplifier Module (645-4196) (See Figure 5-31)	269944	1	1	
A12	Second Up Converter Module (645-4190) (See Figure 5-33)	263707	1	1	
A13	415 MHz Filter, UHF, passband	268763	1		
A14	Output Amplifier Module (645-4193) (See Figure 5-35)	263731	1	1	
A15	Output Mixer Module (645-4191) (See Figure 5-36)	263715	1	1	
TB4	Terminal Board	253427	1		
	RF Cable No. 116	205773	1		
	RF Cable No. 117, 119, 123, 125, 126, 127	205757	6		
	RF Cable No. 118	280594	1		
	RF Cable No. 120, 122, 124	270041	3		
	RF Cable No. 121	205765	1		
	RF Cable No. 128	205781	1		

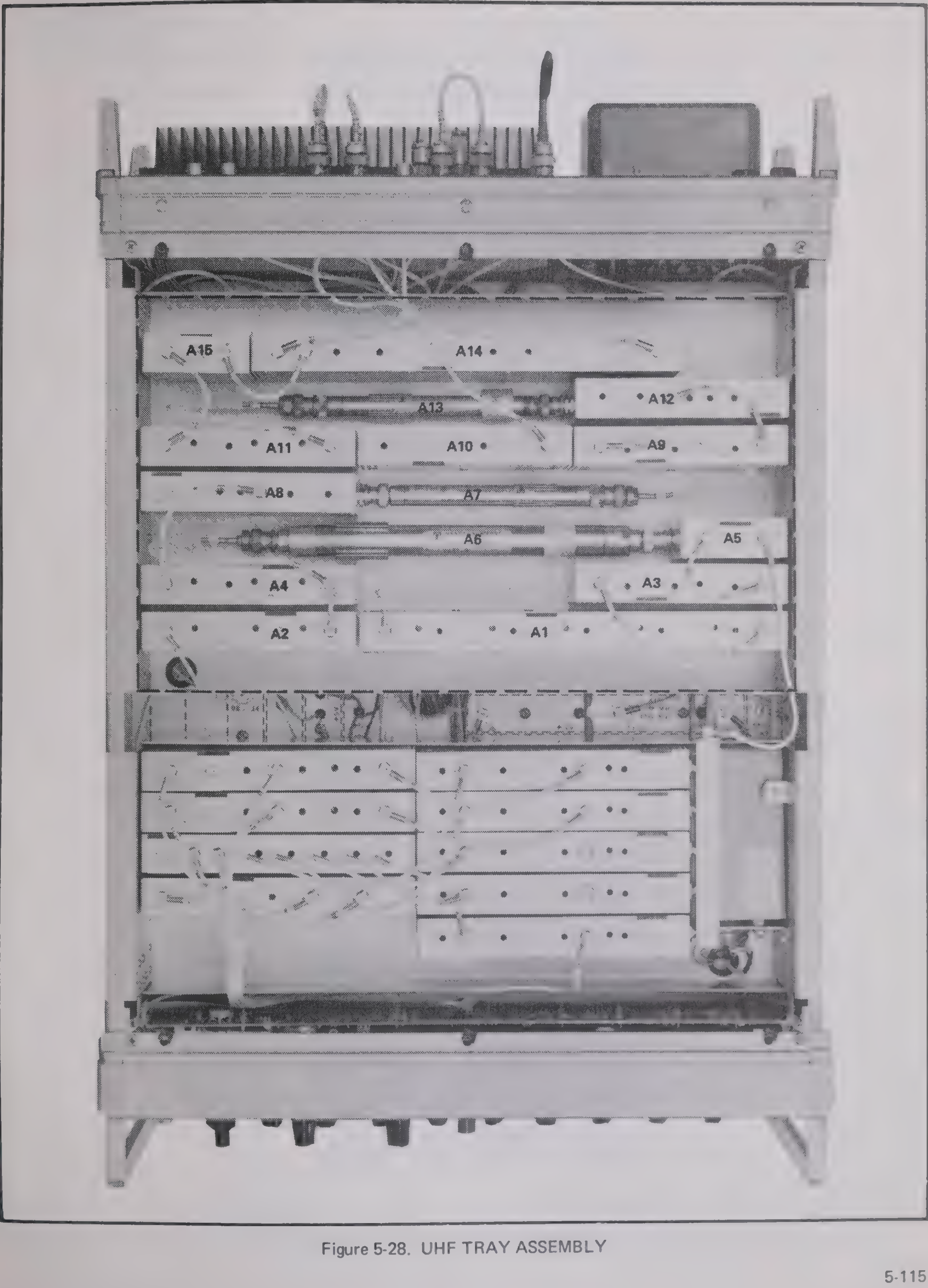
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1

Figure 5-28. UHF TRAY ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A1	**OSCILLATOR MODULE (645-4185) - Figure 5-29**	263657	REF		
A1	Oscillator PCB Assembly (See Figure 5-29)	263947	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	6		
	Frame, enclosure	264895	1		
	Cover, enclosure	252924	2		
	OSCILLATOR PCB ASSEMBLY - Figure 5-29	263947	REF		
A1 thru A5	UHF Tuner	253013	5		
C1, C3, C4, C5, C7, C9, C10, C11, C13, C14, C15, C17, C18, C19, C21, C22, C23	Cap, cer, 500 pf ±10%, 1 kv	105692	17		
C2, C8, C12, C16 C20	Cap, cer, 1000 pf +100/–0%, 300v	266437	5		
C6	Cap, cer, 0.0012 uf ±10%, 500v	106732	1		
C24, C25	Cap, mica, 2 pf ±0.5 pf, 500v	175208	2		F
CR1, CR3, CR5, CR7, CR9	Diode, germanium, 80 ma, 100 piv	149187	5		
CR2, CR4, CR6, CR8, CR10	Diode, silicon, 150 ma	203323	5		
DL1 thru DL5	Delay line	252999	5		
L1 thru L5	Ferrite bead	219535	5		
Q1, Q4, Q7, Q10, Q13	Tstr, silicon, PNP	225599	5		
Q2, Q5, Q8, Q11, Q14	Tstr, silicon, NPN	218396	5		
Q3, Q6, Q9, Q12, Q15	Tstr, silicon, NPN	257170	5		E
Q3, Q6, Q9, Q12, Q15	Tstr silicon, NPN	260638	5		F
R1, R13, R22, R31, R40	Res, comp, 2.2k ±5%, ¼w	148049	5		

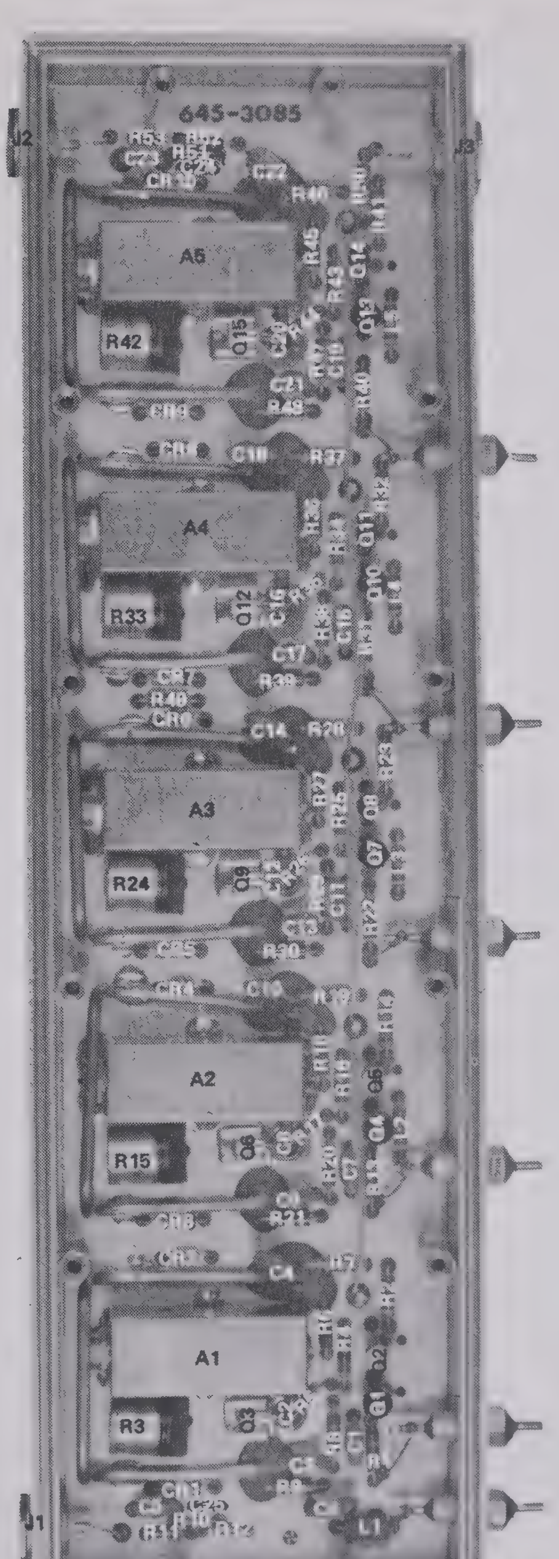
645-3085
J2
J3
A5
R42
R40
Q15
Q14
Q13
C21
CR9
C18
R37
A4
R33
Q12
Q11
Q10
C17
R38
CR7
CR6
C14
R28
A3
R24
Q9
Q8
Q7
C11
CR5
R30
CR4
C10
A2
R15
Q6
Q5
Q4
C7
CR3
R21
C4
R7
A1
R3
Q3
Q2
Q1
C1
C3
R9
CR1
C5
R11
R10
L1
J1

Figure 5-29. OSCILLATOR MODULE (645-4185)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R2, R14, R23, R32, R41	Res, comp, 4.7k ±5%, ¼w	148072	5		
R3, R15, R24, R33, R42	Res, var, cer met, 500Ω ±10%, ½w	256347	5		
R4, R16, R25, R34, R43	Res, comp, 47Ω ±5%, ¼w	147892	5		
R5, R17, R26, R35, R44	Res, comp, 150Ω ±10%, 1/8w	153924	5		
R6, R8, R18, R20, R27, R29, R36, R38, R45, R47, R49	Res, comp, 1k ±5%, ¼w	148023	11		
R7, R19, R28, R37, R46	Res, comp, 3.3k ±5%, ¼w	148056	5		
R9, R21, R30, R39, R48	Res, comp, 100Ω ±5%, ¼w, nominal (factory selected, replace with exact value)	147926	5		
R10, R11, R51, R53	Res, comp, 15Ω ±10%, 1/8w	261800	4		
R12, R52	Res, comp, 68Ω ±10%, 1/8w	261818	2		
R50	Res, comp, 330Ω ±5%, ¼w	147967	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A2	**AGC AMPLIFIER MODULE (645-4192) - Figure 5-30**	263723	REF		
A1	AGC Amplifier PCB Assembly (See Figure 5-30)	264010	1		
J1 thru J4	Connector, male, coaxial	207639	4		
	Cap, feed thru, 2500 pf gmv	248286	1		
	Frame, enclosure	265751	1		
	Cover, enclosure	252908	2		
	AGC AMPLIFIER PCB ASSEMBLY - Figure 5-30	264010	REF		
A1, A2, A3	UHF Tuner	253021	3		
A4	Low pass filter	253039	1		
C1, C4, C7, C10	Cap, cer, 0.005 uf ±20%, 100v	175232	4		G
C1, C4, C7, C10	Cap, cer, 500 pf ±10%, 1 kv	105692	4		H
C2, C5, C8, C11	Cap, cer, 0.0012 uf ±10%, 500v	106732	4		
C3, C6, C9	Cap, cer, 270 pf ±10%, 300v	266429	3		
CR1	Diode, silicon, 150 ma	203323	1		
L1	Ferrite bead	219535	1		
Q1, Q2, Q3	Tstr, silicon, NPN	257170	3		
R1	Res, comp, 22Ω ±5%, ¼w	147884	1		
R2, R9	Res, comp, 3.9k ±5%, ¼w	148064	2		
R3, R7	Res, comp, 2.2k ±5%, ¼w	148049	2		
R4	Res, comp, 1k ±10%, 1/8w	153916	1		
R5, R11	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R10, R16	Res, comp, 470Ω ±10%, 1/8w	153981	3		
R8	Res, comp, 680Ω ±10%, 1/8w	115311	1		
R12	Res, comp, 27Ω ±5%, ¼w	160812	1		
R13	Res, comp, 1k ±5%, ¼w	148023	1		
R14	Res, comp, 1.5k ±5%, ¼w	148031	1		
R15	Res, comp, 120Ω ±5%, ¼w	170712	1		
R17	Res, comp, 100Ω ±10%, 1/8w	261826	1		

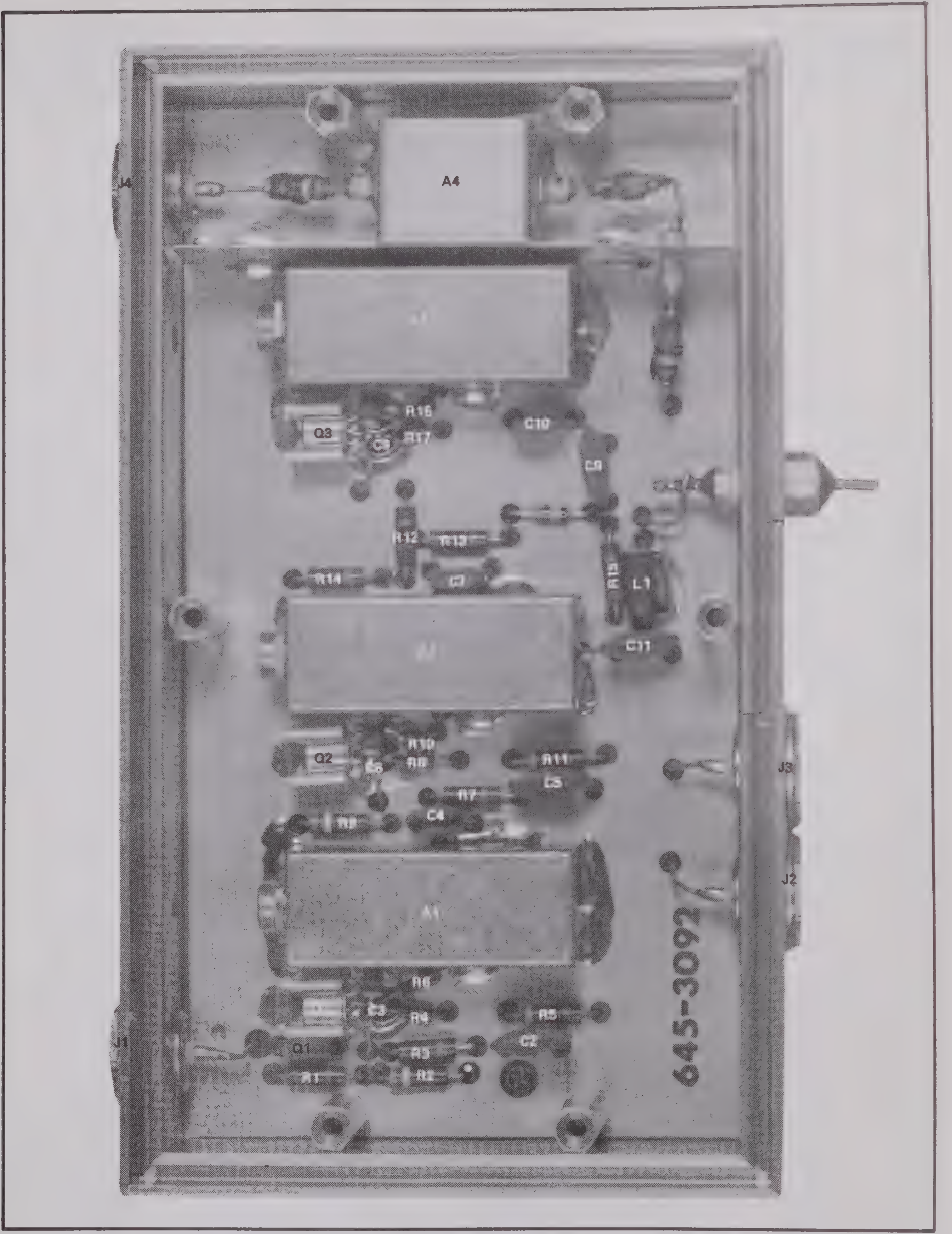
A4
J4
R16
Q3
R17
C10
C9
R12
R13
R14
C7
R15
L1
C11
R10
Q2
R8
R11
C5
R7
R9
C4
J3
A1
J2
645-3092
R6
C3
R4
R5
J1
Q1
R3
C2
R1
R2

Figure 5-30. AGC AMPLIFIER MODULE (645-4192)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A3	**390 MHz 3-STAGE AMPLIFIER MODULE (645-4186)**	263665	REF		
A5A9	**380 MHz 3-STAGE AMPLIFIER MODULE (645-4195) Figure 5-31**	269936	REF		
A1	380 MHz & 390 MHz 3-Stage Amplifier PCB Assembly (See Figure 5-31)	263954	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	1		
	Frame, enclosure	264879	1		
	Cover, enclosure	252908	2		
	380 MHz & 390 MHz 3-STAGE AMPLIFIER PCB ASSEMBLY - Figure 5-31	263954	REF		
A1, A2, A3	UHF Tuner	253021	3		
A4	Low pass filter	253039	1		
C1, C4, C7, C10	Cap, cer, 0.005 uf ±20%, 100v	175232	4		G
C1, C4, C7, C10	Cap, cer, 500 pf ±10%, 1 kv	105692	4		H
C2, C5, C8, C11	Cap, cer, 0.0012 uf ±10%, 500v	106732	4		
C3, C6, C9	Cap, cer, 270 pf ±10%, 300v	266429	3		
CR1	Diode, silicon, 150 ma	203323	1		
L1	Ferrite bead	219535	1		
Q1, Q2, Q3	Tstr, silicon, NPN	257170	3		
R1	Res, comp, 22Ω ±5%, ¼w	147884	1		
R2, R7	Res, comp, 3.9k ±5%, ¼w	148064	2		
R3, R8, R14	Res, comp, 2.2k ±5%, ¼w	148049	3		
R4	Res, comp, 1k ±10%, 1/8w	153916	1		
R5, R10	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6, R12	Res, comp, 470Ω ±10%, 1/8w	153981	2		
R9	Res, comp, 680Ω ±10%, 1/8w	115311	1		
R11	Res, comp, 120Ω ±5%, ¼w	170712	1		
R13	Res, comp, 3.3k ±5%, ¼w	148056	1		
R15	Res, comp, 27Ω ±5%, ¼w	160812	1		
R16	Res, var, cer met, 1k ±10%, ½w	261768	1		
R17	Res, comp, 270Ω ±10%, 1/8w	261834	1		

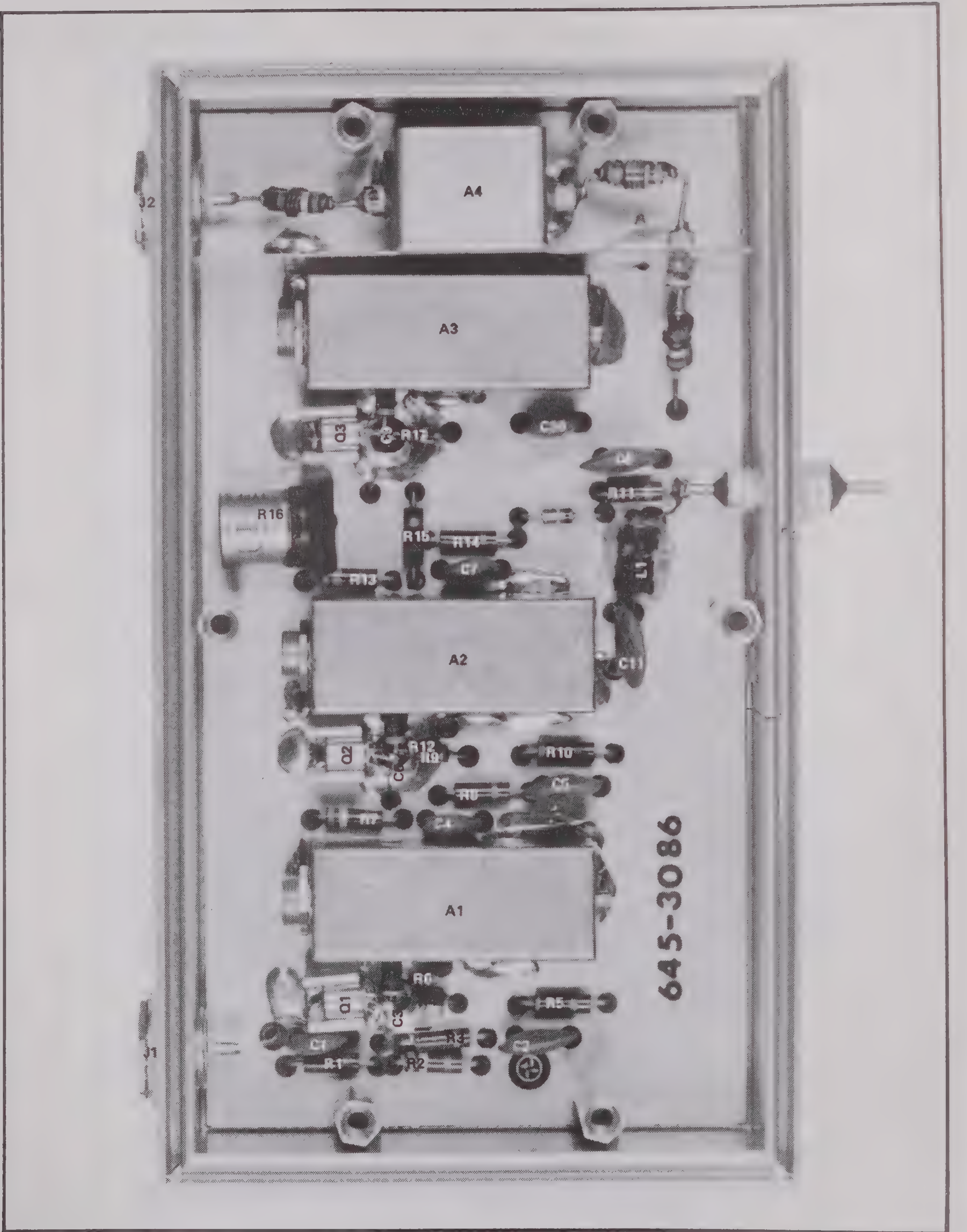
J2
A4
A3
Q3
R17
C10
R11
R16
R15
R14
C7
R13
L1
A2
C11
Q2
R12
R9
C6
R10
R8
C5
R7
C4
645-3086
A1
R6
Q1
R5
C3
R3
C1
C2
R1
R2
J1

Figure 5-31. 340 MHz 3-STAGE AMPLIFIER MODULE (645-4188), 380 MHz 3-STAGE AMPLIFIER MODULE (645-4195)
390 MHz 3-STAGE AMPLIFIER MODULE (645-4186), 415 MHz 3-STAGE AMPLIFIER MODULE (645-4196)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A4 A5A11	**340 MHz 3-STAGE AMPLIFIER MODULE (645-4188)** **415 MHz 3-STAGE AMPLIFIER MODULE (645-4196)** **Figure 5-31**	263681 269944	REF REF		
A1	340 MHz & 415 MHz 3-Stage Amplifier PCB Assembly (See Figure 5-31)	263970	1		
J1, J2	Connector, male, coaxial	207639	2		
	Cap, feed thru, 2500 pf gmv	248286	1		
	Frame, enclosure	264879	1		
	Cover, enclosure	252908	2		
	340 MHz & 415 MHz 3-STAGE AMPLIFIER PCB ASSEMBLY - Figure 5-31	263970	REF		
A1, A2, A3	UHF Tuner	253021	3		
A4	Low pass filter	253039	1		
C1, C4, C7, C10	Cap, cer, 0.005 uf ±20%, 100v	175232	4		G
C1, C4, C7, C10	Cap, cer, 500 pf ±10%, 1 kv	105692	4		H
C2, C5, C8, C11	Cap, cer, 0.0012 uf ±10%, 500v	106732	4		
C3, C6, C9	Cap, cer, 270 pf ±10%, 300v	266429	3		
CR1	Diode, silicon, 150 ma	203323	1		
L1	Ferrite bead	219535	1		
Q1, Q2, Q3	Tstr, silicon, NPN	257170	3		
R1	Res, comp, 22Ω ±5%, ¼w	147884	1		
R2, R7	Res, comp, 3.9k ±5%, ¼w	148064	2		
R3, R8, R14	Res, comp, 2.2k ±5%, ¼w	148049	3		
R4	Res, comp, 1k ±10%, 1/8w	153916	1		
R5, R10	Res, comp, 47Ω ±5%, ¼w	147892	2		
R6	Res, var, cer met, 1k ±10%, ½w	261768	1		
R9	Res, comp, 680Ω ±10%, 1/8w	115311	1		
R11	Res, comp, 120Ω ±5%, ¼w	170712	1		
R12	Res, comp, 270Ω ±10%, 1/8w	261834	1		
R13	Res, comp, 3.3k ±5%, ¼w	148056	1		
R15	Res, comp, 27Ω ±5%, ¼w	160812	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A5	**INPUT MIXER MODULE (645-4187) Figure 5-32**	263673	REF		
A1	Input Mixer PCB Assembly (See Figure 5-32)	263962	1		
J1, J2	Connector, male, coaxial	207639	2		
J3	Connector, coaxial, female, BNC	216549	1		
	Frame, enclosure	264903	1		
	Cover, enclosure	252932	2		
	Plug, threaded	207084	1		
	INPUT MIXER PCB ASSEMBLY - Figure 5-32	263962	REF		
A1	Low pass filter	253047	1		
IC1	Mixer, double balanced	266007	1		
L1	Inductor, 0.22 uh, 2050 ma	261735	1		
R1	Res, comp, 3.3Ω ±5%, ¼w	182279	1		

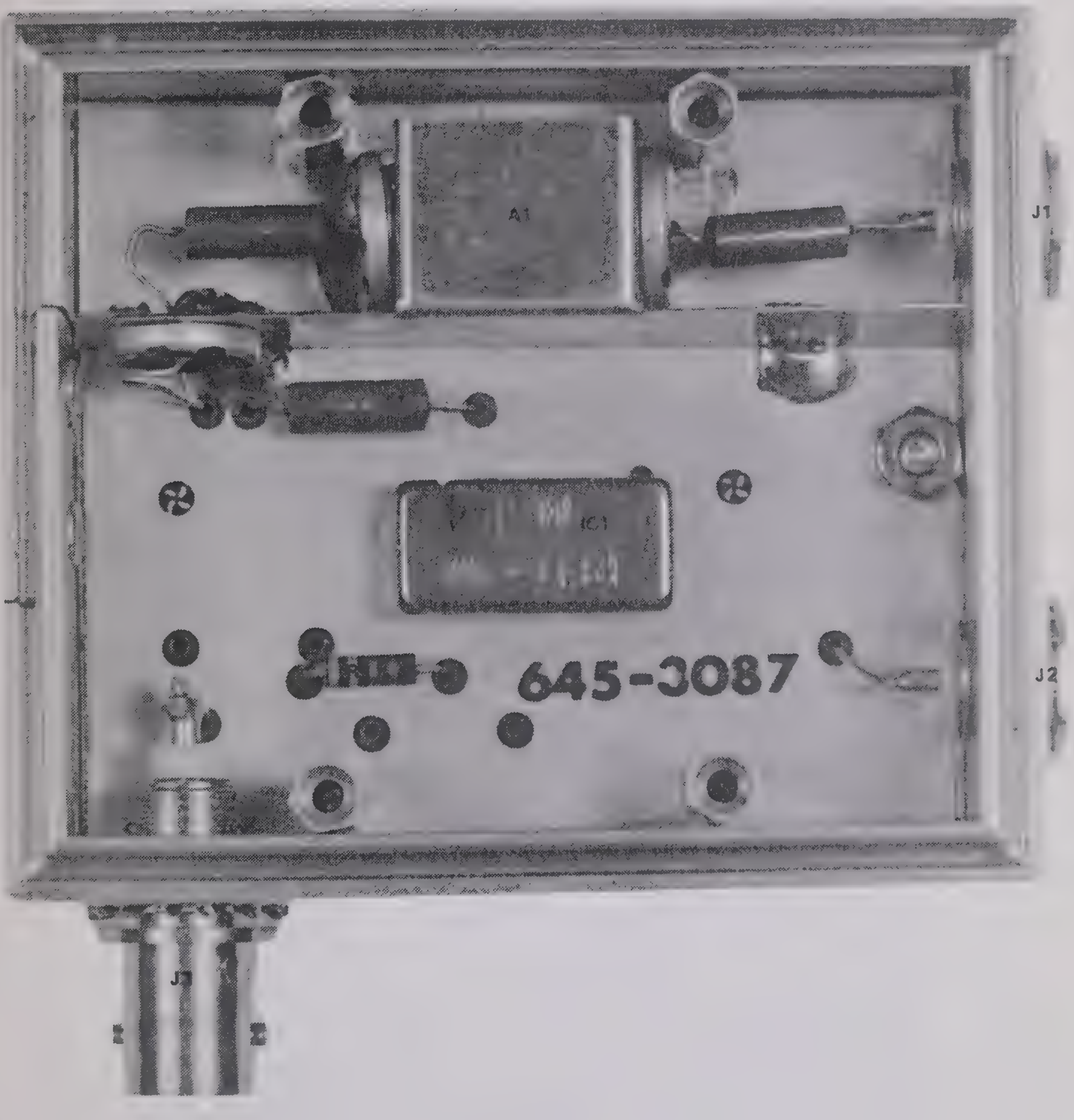
A1
J1
IC1
645-3087
J2
J3

Figure 5-32. INPUT MIXER MODULE (645-4187)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A8	**FIRST UP CONVERTER MODULE (645-4189)** **Figure 5-33**	263699	REF		
A1	First Up Converter PCB Assembly (See Figure 5-33)	263988	1		
J1, J2	Connector, male, coaxial	207639	2		
J3	Connector, coaxial, female, BNC	216549	1		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265785	1		
	Cover, enclosure	252908	2		
	FIRST UP CONVERTER PCB ASSEMBLY Figure 5-33	263988	REF		
A1	Low pass filter	253054	1		
C1	Cap, mica, 12 pf ±5%, 500v	175224	1		
C2	Cap, mica, 100 pf ±5%, 500v	148494	1		
C3	Cap, cer, 2.2 pf ±0.25 pf, 500v	272484	1		
C4, C5	Cap, mica, 82 pf ±5%, 500v	148502	2		
C6, C10	Cap, var, 0.8 - 10 pf, 250v	229930	2		
C7	Cap, cer, 3.3 pf ±0.25 pf, 500v	272492	1		
C8, C9	Cap, cer, 5 pf ±0.25 pf, 500v	272500	2		
C11, C13	Cap, cer, 0.01 uf ±20%, 100v	149153	2		
C12, C14	Cap, elect, 10 uf ±20%, 6v	106906	2		
CR1, CR2	Varactor, diode, pair	267757	2		
L1	Inductor, RF, 16 turns, 7.9 MHz	255919	1		
L2	Inductor, RF, 8 turns, 25 MHz	255505	1		
L3, L4	Inductor, 0.1 uh, 3000 ma	257154	2		
R1, R2	Res, comp, 3.3Ω ±5%, ¼w	182279	2		
R3, R4, R5, R8	Res, comp, 10k ±5%, ¼w	148106	4		
R6	Res, comp, 4.7k ±5%, ¼w	148072	1		
R7	Res, comp, 2.7k ±5%, ¼w	170720	1		
R9, R10, R12	Res, comp, 1k ±5%, ¼w	148023	3		

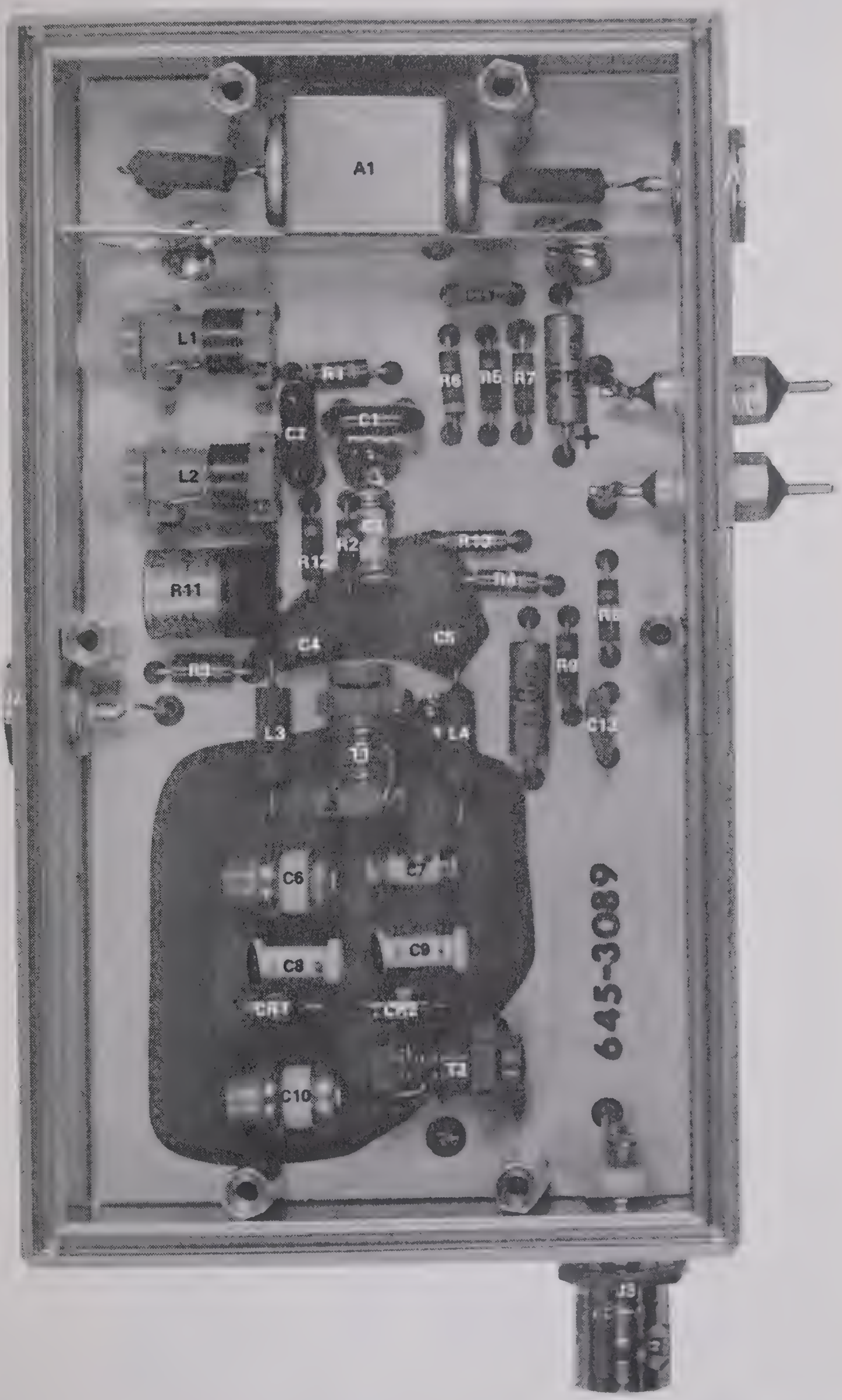
A1
L1
R1
R6
R5
R7
C1
C2
L2
R2
R12
R10
R11
R4
R8
C4
C5
R3
R9
L3
L4
T1
C11
C6
C7
C8
C9
CR1
CR2
T2
C10
645-3089
J3

Figure 5-33. FIRST UP CONVERTER MODULE (645-4189)
SECOND UP CONVERTER MODULE (645-4190)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R11	Res, var, cer met, 2k ±10%, ½w	261750	1		
T1	Transformer, RF	265611	1		
T2	Transformer, RF	265629	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A10	**AMPLITUDE CONTROL MODULE (645-4194)** **Figure 5-34**	263749	REF		
A1	Amplitude Control PCB Assembly (See Figure 5-34)	264036	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Cap, feed thru, 2500 pf gmv	248286	4		
	Frame, enclosure	265769	1		
	Cover, enclosure	252908	2		
	AMPLITUDE CONTROL PCB ASSEMBLY Figure 5-34	264036	REF		
C1, C2	Cap, cer, 0.01 uf ±20%, 100v	149153	2		
C3	Cap, cer, 0.68 uf +80/–20%, 25v	179077	1		
CR1, CR2, CR3	Diode, silicon, 75v	234450	3		
CR4 thru CR8	Diode, silicon, 150 ma	203323	5		
Q1, Q4, Q5, Q10	Tstr, silicon, NPN	218396	4		
Q2, Q8	Tstr, silicon, PNP	242016	2		
Q3, Q6, Q7, Q9, Q11	Tstr, silicon, PNP	225599	5		
R1	Res, var, cer met, 5k ±10%, ½w	256354	1		
R2, R3	Res, comp, 3.3k ±5%, ¼w	148056	2		
R4	Res, comp, 2.7k ±5%, ¼w	170720	1		
R5, R6, R9, R10	Res, comp, 470Ω ±5%, ¼w	147983	4		
R7, R8	Res, comp, 6.8k ±5%, ¼w	148098	2		
R11, R15	Res, comp, 4.7Ω ±5%, ¼w	193359	2		
R12, R24	Res, comp, 10k ±5%, ¼w	148106	2		
R13, R14, R25, R26, R27, R31, R32	Res, comp, 2.2k ±5%, ¼w	148049	7		
R16	Res, var, cer met, 2k ±10%, ½w	261750	1		

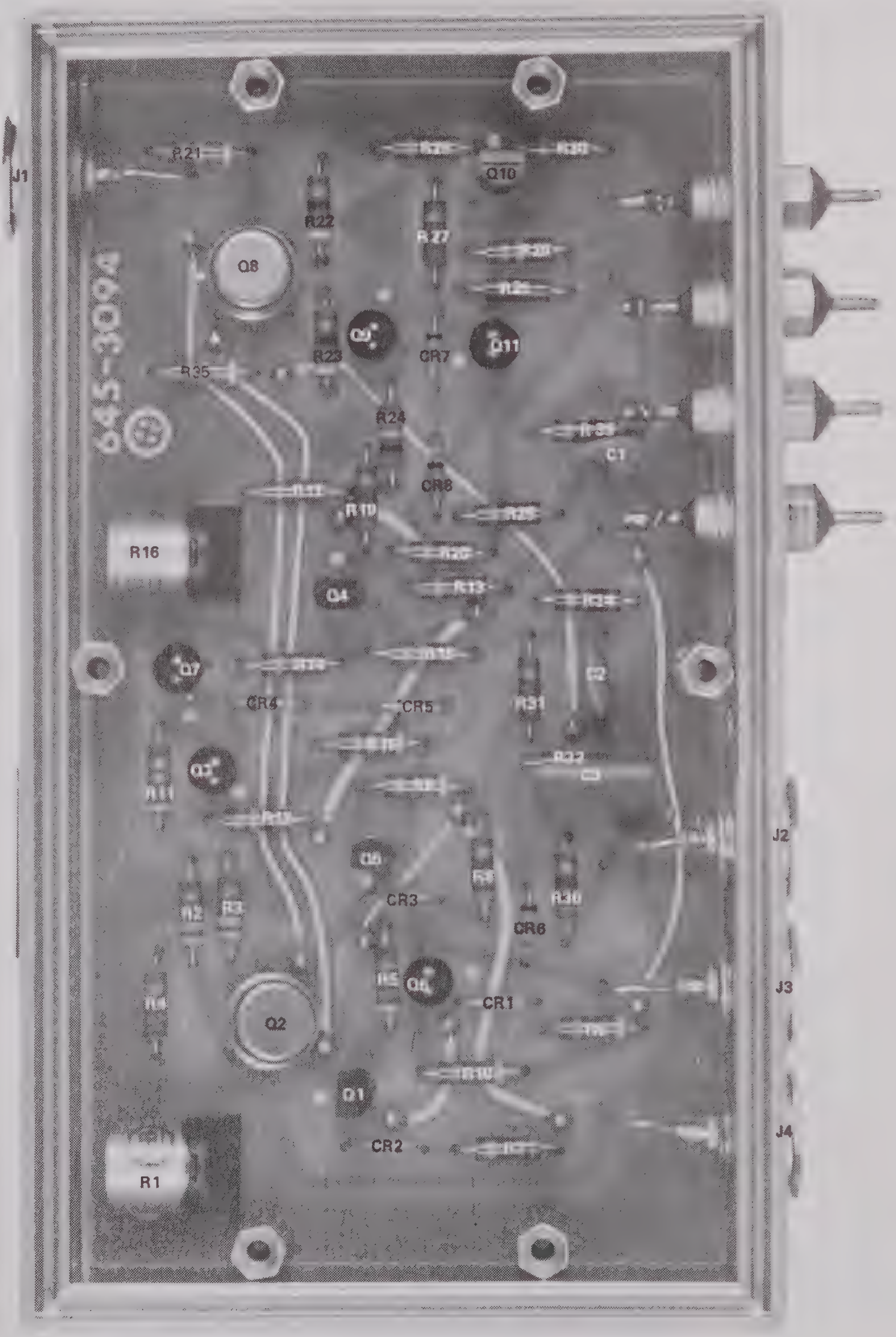
J1
R21
Q10
R22
R27
Q8
645-309A
Q9
Q11
R23
CR7
R35
R24
C1
CR8
R10
R16
Q4
Q7
CR4
CR5
C2
R31
C3
Q3
R11
J2
Q5
CR3
R2
R3
R30
CR6
R5
Q6
CR1
J3
Q2
R4
Q1
CR2
R1
J4

Figure 5-34. AMPLITUDE CONTROL MODULE (645-4194)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R17	Res, comp, 1.2k ±5%, ¼w	190371	1		
R18, R28	Res, comp, 12k ±5%, ¼w	159731	2		
R19, R20, R29, R30	Res, comp, 1.5k ±5%, ¼w	148031	4		
R21, R35	Res, comp, 47k ±5%, ¼w	148163	2		
R22, R23	Res, comp, 47Ω ±5%, ¼w	147892	2		
R33, R34	Res, comp, 100Ω ±5%, ¼w	147926	2		
R36	Res, comp, 1k ±5%, ¼w	148023	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A12	**SECOND UP CONVERTER MODULE (645-4190)** **Figure 5-33**	263707	REF		
A1	Second Up Converter PCB Assembly (See Figure 5-33)	263996	1		
J1, J2	Connector, male, coaxial	207639	2		
J3	Connector, coaxial, female, BNC	216549	1		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265785	1		
	Cover, enclosure	252908	2		
	SECOND UP CONVERTER PCB ASSEMBLY Figure 5-33	263996	1		
A1	Low pass filter	253054	1		
C1, C2	Cap, mica, 68 pf ±5%, 500v	148510	2		
C3, C7	Cap, cer, 2.2 pf ±0.25 pf, 500v	272484	2		
C4, C5	Cap, cer, 0.005 uf ±20%, 100v	175232	2		G
C4, C5	Cap, cer, 500 pf ±10%, 1 kv	105692	2		H
C6, C10	Cap, var, 0.8 - 10 pf, 250v	229930	2		
C8, C9	Cap, cer, 3.3 pf ±0.25 pf, 500v	272492	2		
C11, C13	Cap, cer, 0.01 uf ±20%, 100v	149153	2		
C12, C14	Cap, elect, 10 uf ±20%, 6v	106906	2		
CR1, CR2	Varactor, diode, pair	267757	2		
L1, L2	Inductor, RF, 9 turns, 25 MHz	269035	2		
L3, L4	Inductor, 0.1 uh, 3000 ma	257154	2		
R1	Res, comp, 3.3Ω ±5%, ¼w	182279	1		
R2	Res, comp, 10Ω ±5%, ¼w	147868	1		
R3, R4, R5, R8	Res, comp, 10k ±5%, ¼w	148106	4		
R6	Res, comp, 4.7k ±5%, ¼w	148072	1		
R7	Res, comp, 2.7k ±5%, ¼w	170720	1		C
R7	Res, comp, 1.8k ±5%, ¼w	175042	1		D
R9, R10, R12	Res, comp, 1k ±5%, ¼w	148023	3		
R11	Res, var, cer met, 2k ±10%, ½w	261750	1		
R12	Res, comp, 1k ±5%, ¼w	148023	REF		C
R12	Res, comp, 560Ω ±5%, ¼w	147991	1		D
T1	Transformer, RF	265611	1		
T2	Transformer, RF	265629	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A14	OUTPUT AMPLIFIER MODULE (645-4193) - Figure 5-35	263731	REF		
A1	Output Amplifier PCB Assembly (See Figure 5-35)	264028	1		
J1 thru J4	Connector, male, coaxial	207639	4		
	Cap, feed thru, 2500 pf gmv	248286	2		
	Frame, enclosure	265777	1		
	Cover, enclosure	252924	2		
	OUTPUT AMPLIFIER PCB ASSEMBLY - Figure 5-35	264028	REF		
C1	Cap, mica, 100 pf ±5%, 500v	148494	1		
C2	Cap, mica, 4 pf ±5%, 500v	190397	1		
C3, C4, C6, C8	Cap, Ta, 68 uf ±10%, 15v	182824	4		
C5, C21	Cap, cer, 0.01 uf ±20%, 100v	149153	2		
C7	Cap, Ta, 15 uf ±10%, 20v	153056	1		
C9	Cap, mica, 39 pf ±5%, 500v	148544	1		
C10	Cap, var, 7 -25 pf, 350v	229948	1		
C11, C14, C19, C20, C22, C24, C25	Cap, Ta, 150 uf ±10%, 15v	248385	7		
C12, C13, C23	Cap, Ta, 330 uf ±10%, 6v	193011	3		
C15	Cap, plstc, 0.047 uf ±10%, 250v	162008	1		
C16	Cap, cer, 0.68 uf +80/–20%, 25v	179077	1		
C17, C18	Cap, Ta, 22 uf ±10%, 15v	182816	2		
CR1	Diode, silicon, 75v	234450	1		
CR2, CR3	Diode, high speed switching	256339	2		
IC1	IC, operational amplifier	246603	1		
L1	Inductor, RF, 16 turns, 7.9 MHz	255919	1		
L2, L5, L6	Inductor, 10 uh, 432 ma	249078	3		
L3, L4	Inductor, 1 uh, 2300 ma	207589	2		
Q1, Q2	Tstr, silicon, NPN	246264	2		
Q3, Q4	Tstr, silicon, NPN	248351	2		

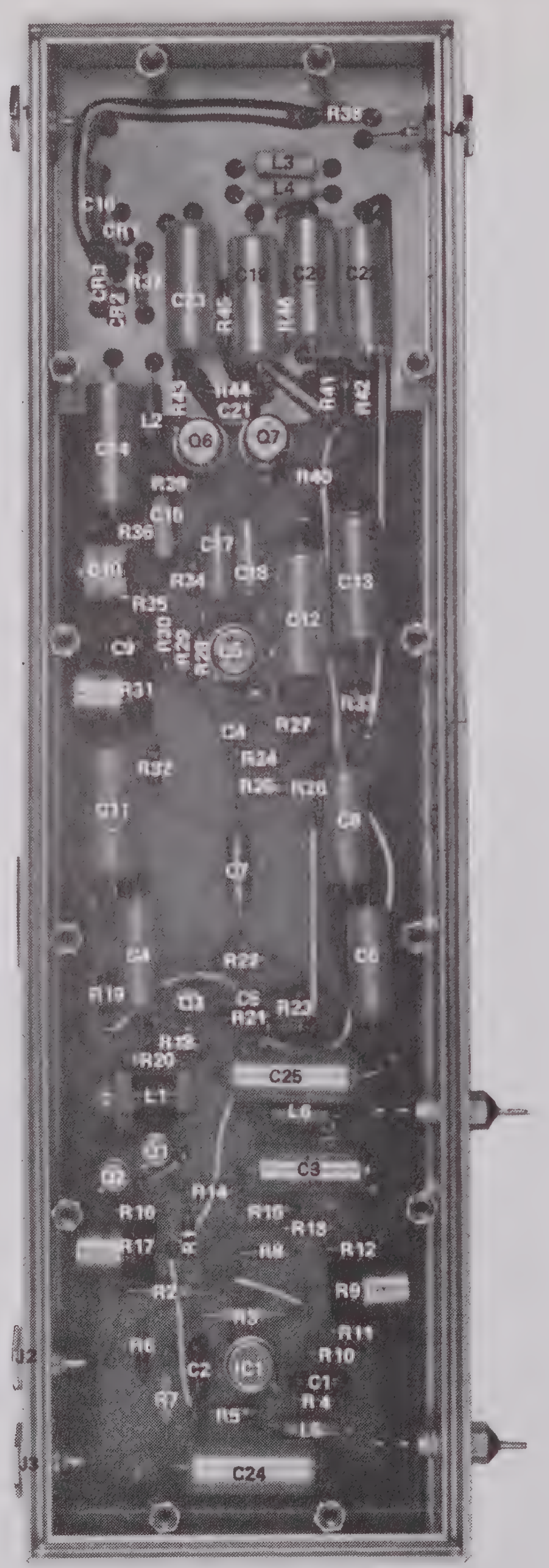
R38
L3
L4
R37
C23
C19
C20
C22
R45
R46
R44
C21
R41
R42
L2
Q6
Q7
C14
R39
R40
C16
R36
C17
R34
C18
C13
R35
C12
C9
R30
R29
R28
R31
R27
R24
R32
R25
R26
C11
C8
C7
R22
C6
R19
Q3
C5
R21
R23
R18
R20
C25
L1
L6
Q1
C3
Q2
R14
R16
R15
R13
R17
R1
R8
R12
R2
R9
R3
R11
R6
J2
R10
C2
IC1
C1
R7
R5
R4
L5
J3
C24

Figure 5-35. OUTPUT AMPLIFIER MODULE (645-4193)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q5, Q6, Q7	Tstr, silicon, NPN	272930	3		
R1, R32	Res, comp, 56Ω ±5%, ¼w	147900	2		
R2	Res, met flm, 1k ±1%, 1/8w	168229	1		
R3	Res, met flm, 61.9k, ±1%, 1/8w	237230	1		L
R3	Res, met flm, 68.1k ±1%, 1/8w	236828	1		
R4, R22	Res, comp, 1.5k ±5%, ¼w	148031	2		
R5, R8, R11, R12, R43, R44	Res, comp, 100Ω ±5%, ¼w	147926	6		
R6, R16, R38, R39, R40	Res, comp, 1k ±5%, ¼w	148023	5		
R7	Res, met flm, 590Ω ±1%, 1/8w	261883	1		
R9	Res, var, cer met, 5k ±10%, ½w	256354	1		
R10, R13	Res, comp, 22k ±5%, ¼w	148130	2		
R14, R21	Res, comp, 2.2k ±5%, ¼w	148049	2		
R15, R24, R37	Res, comp, 3.3k ±5%, ¼w	148056	3		
R17	Res, var, cer met, 10k ±10%, ½w	261784	1		
R18	Res, comp, 680Ω ±5%, ¼w	148007	1		
R19, R25	Res, comp, 2.7k ±5%, ¼w	170720	2		
R20, R29	Res, comp, 47Ω ±5%, ¼w	147892	2		
R23	Res, comp, 6.8k ±5%, ¼w	148098	1		
R26	Res,comp, 1.2k ±5%, ¼w	190371	1		
R27	Res, comp, 620Ω ±5%, ¼w	221903	1		
R28	Res, comp, 5.6k ±5%, ¼w	148080	1		
R30, R41, R42	Res, comp, 150Ω ±5%, ¼w	147934	3		
R31	Res, var, cer met, 500Ω ±10%, ½w	256347	1		
R33	Res, comp, 220Ω ±5%, ¼w	147959	1		
R34, R35	Res, comp, 110Ω ±5%, ¼w	193474	2		
R36	Res, comp, 27Ω ±5%, ¼w	160812	1		
R45, R46	Res, comp, 430Ω ±5%, ¼w	203869	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5A15	**OUTPUT MIXER MODULE (645-4191) - Figure 5-36**	263715	REF		
A1	Output Mixer PCB Assembly (See Figure 5-36)	264002	1		
J1 thru J3	Connector, male, coaxial	207639	3		
	Frame, enclosure	264903	1		
	Cover, enclosure	252932	2		
	Plug, threaded	207084	1		
	OUTPUT MIXER PCB ASSEMBLY - Figure 5-36	264002	REF		
A1	Low pass filter	253062	1		
IC1	Mixer, double balanced	266007	1		
L1	Inductor, 0.22 uh, 2050 ma	261735	1		
R1	Res, comp, 200Ω ±5%, ¼w	193482	1		
R2, R3	Res, comp, 62Ω ±5%, ¼w	261842	2		

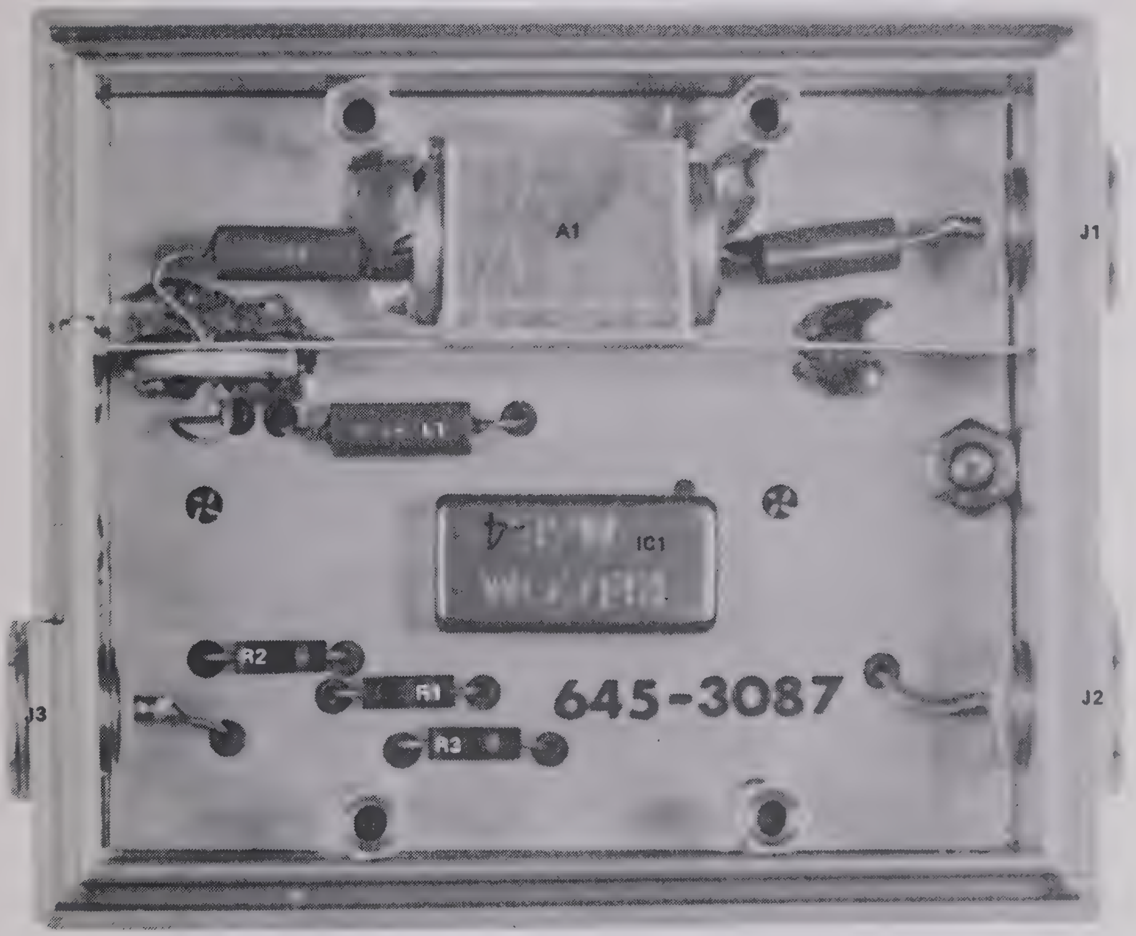
A1
J1
IC1
R2
R1
645-3087
J3
J2
R3

Figure 5-36. OUTPUT MIXER MODULE (645-4191)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**REAR PANEL ASSEMBLY - Figure 5-37**				
A1	Power Supply PCB Assembly (see Figure 5-38)	265603	1	1	
F1, F2	Fuse, 1 amp, slo-blo, 250v (For 100v and 115v operation)	109272	2	2	
F1, F2	Fuse, ½ amp, slo-blo, 250v (For 200v and 230v operation)	109322	2	2	
J1	Connector, 132 contact, REMOTE INPUT	275461	1		
J4 thru J9, J12 thru J19	Connector, female, BNC	222364	14		
J22	Connector, power (RFI filter)	261198	1		
S1	Switch, LINE VOLTAGE	249011	1		
Q1 thru Q5	Tstr, silicon, NPN	268250	5	2	
T1	Transformer, power	275024	1		
XF1, XF2	Fuse holder	160846	2		
	Heat sink	252684	1		
	Hole plug	101774	6		
	Hole plug	170118	1		
	Foot	279836	4		
	Panel, rear	252643	1		

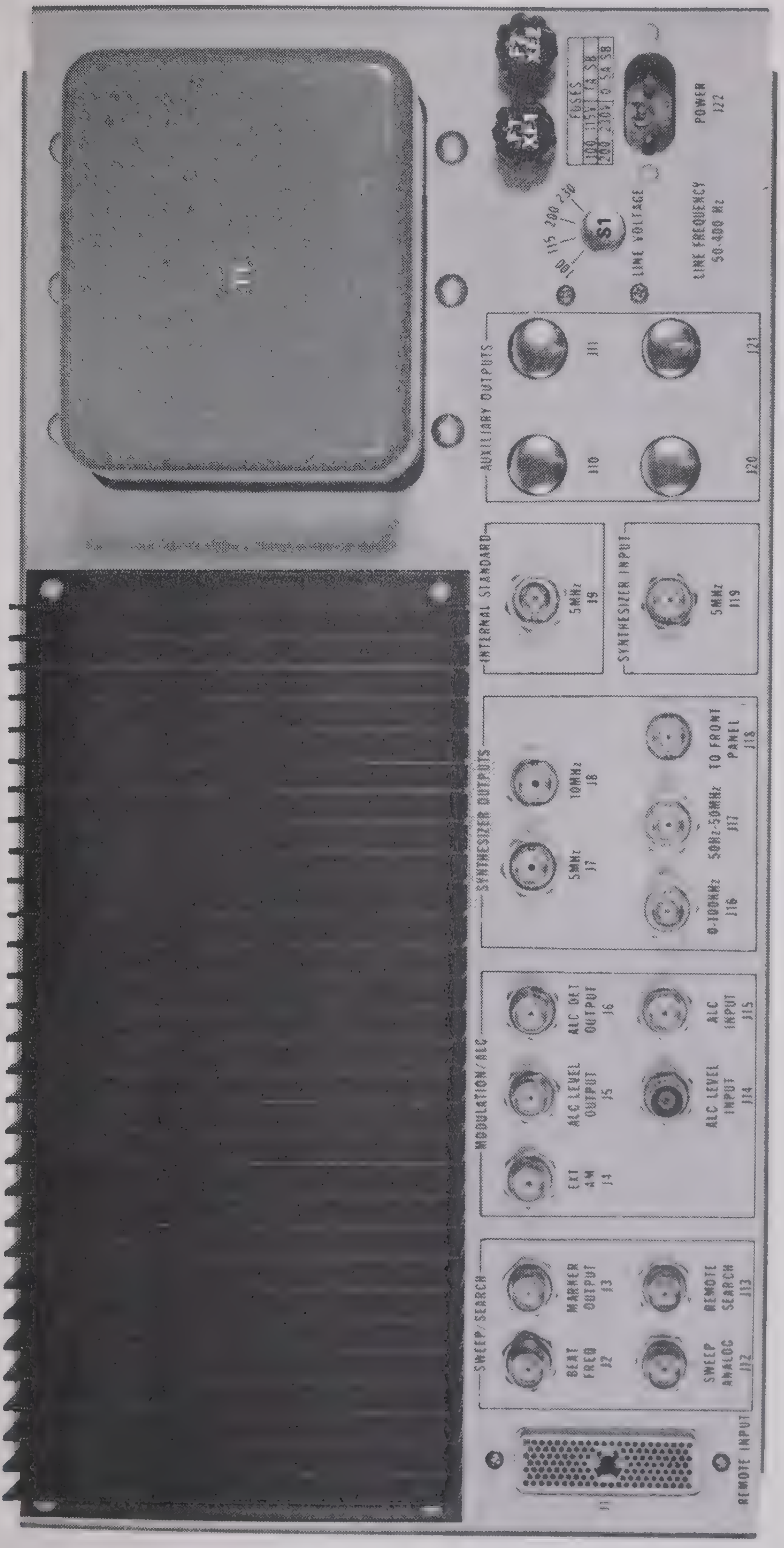
FUSES
POWER
J22
LINE FREQUENCY
50-400 Hz
LINE VOLTAGE
S1
AUXILIARY OUTPUTS
J11
J10
J21
J20
INTERNAL STANDARD
5MHz
J9
SYNTHESIZER INPUT
5MHz
J19
SYNTHESIZER OUTPUTS
5MHz
J7
10MHz
J8
0-100MHz
J16
50Hz-50MHz
J17
TO FRONT PANEL
J18
MODULATION/ALC
EXT AM
J4
ALC LEVEL OUTPUT
J5
ALC DET OUTPUT
J6
ALC LEVEL INPUT
J14
ALC INPUT
J15
SWEEP/SEARCH
BEAT FREQ
J2
MARKER OUTPUT
J3
SWEEP ANALOG
J12
REMOTE SEARCH
J13
REMOTE INPUT
J1

Figure 5-37. REAR PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6A1	**POWER SUPPLY PCB ASSEMBLY - Figure 5-38**	265603	REF		
C1, C9	Cap, elect, 2100 uf +75/–10%, 40v	248666	2		
C2, C5, C10, C13	Cap, mica, 33 pf ±5%, 500v	160317	4		
C4, C12	Cap, elect, 160 uf +50/–10%, 25v	236901	2		
C7, C15, C19, C22	Cap, elect, 200 uf +50/–10%, 10v	236935	4		
C8, C16	Cap, elect, 250 uf +50/–10%, 16v	187765	2		
C17	Cap, elect, 2500 uf +75/–10%, 15v	268003	1		
C18	Cap, elect, 950 uf +75/–10%, 15v	268029	1		
C20	Cap, plstc, 0.22 uf ±10%, 250v	194803	1		
C21	Cap, Ta, 22 uf ±10%, 15v	182816	1		
CR1, CR12, CR23	Diode, 2.5 amp bridge rectifier	236547	3		
CR2, CR5, CR6, CR7, CR10, CR11 CR13,CR16, CR17,CR18, CR21,CR22, CR26,CR27	Diode, silicon, 150 ma	203323	14		
CR3, CR8, CR14,CR19	Diode, zener, 4.3v	180455	4		
CR4, CR9, CR15,CR20, CR28	Diode, zener, 6.3v, 7.5 ma	172148	5		
CR24, CR25	Diode, silicon, 1 amp, 100 piv	116111	2		
IC1 thru IC4	IC, operational amplifier	268961	4		G
IC1 thru IC4	IC, operational amplifier	271502	4		H
Q1, Q5, Q8, Q12, Q17	Tstr, silicon, PNP	226290	5		
Q3, Q4, Q7, Q10, Q11, Q14	Tstr, silicon, NPN	203489	6		
Q15, Q16, Q20, Q21	Tstr, silicon, NPN	168708	4		
Q19	Tstr, silicon, NPN	234054	1		
R1, R26	Res, comp, 2.2k ±5%, ½w	108506	2		
R2, R17, R27, R41, R56	Res, comp, 220Ω ±5%, ¼w	147959	5		

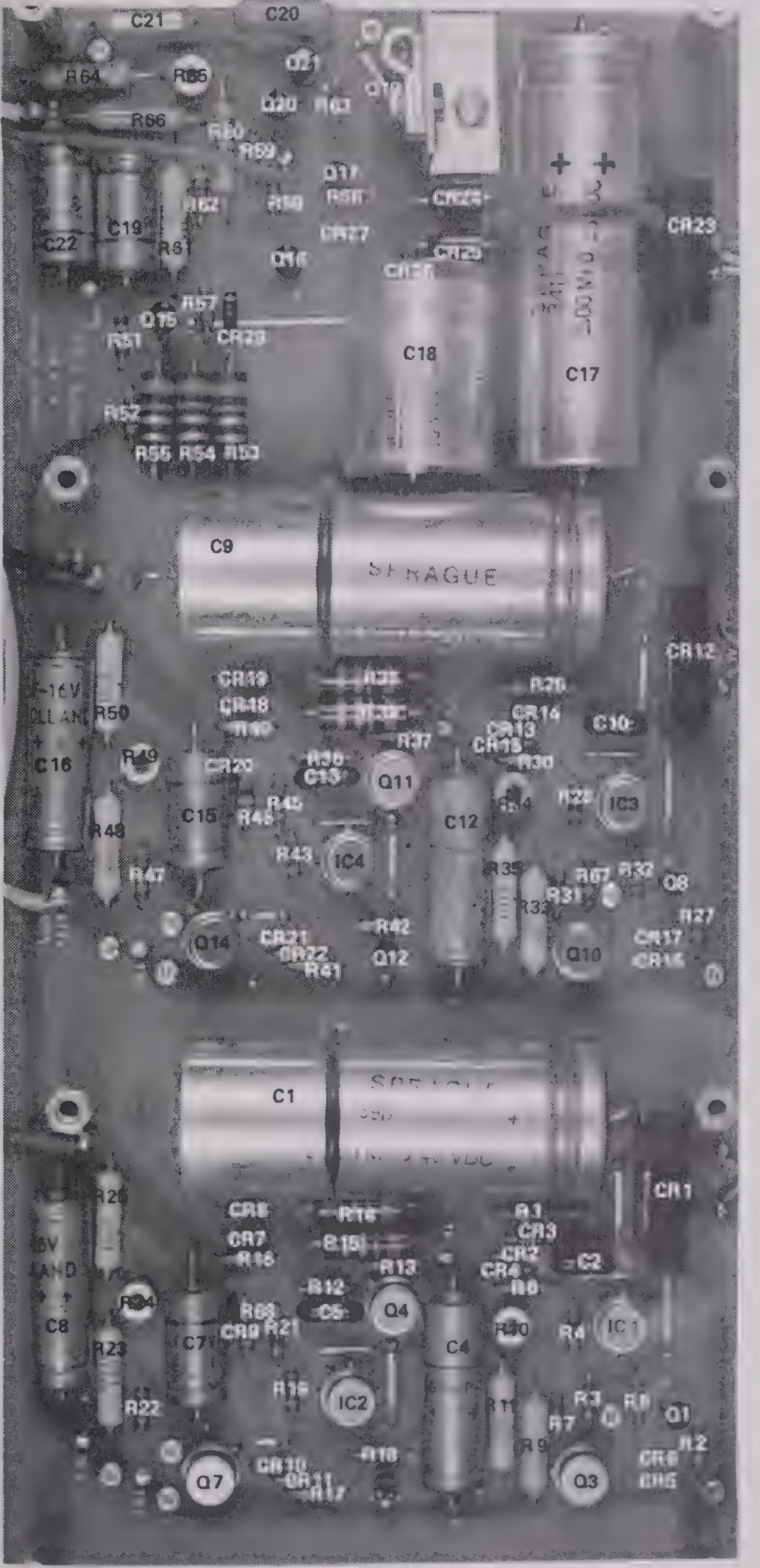
C21
C20
R64
R65
Q21
Q20
R63
Q19
R66
R60
R59
Q17
R58
R62
R59
C22
C19
R61
CR27
CR25
CR26
Q16
CR23
R57
Q15
R51
CR28
C18
C17
R52
R55
R54
R53
C9
SPRAGUE
CR12
CR19
CR18
R40
R38
R39
R20
CR14
C10
R50
CR13
R37
CR15
R30
R49
C16
CR20
R36
C13
Q11
C15
R45
R46
C12
R34
R29
IC3
R48
R43
IC4
R35
R47
R67
R32
Q8
R31
R33
R27
Q14
CR21
CR22
R41
R42
Q12
Q10
CR17
CR16
C1
CR1
R25
CR8
R14
R1
CR7
R15
CR3
R16
CR2
C2
R13
CR4
R12
R6
R24
R68
C5
Q4
C8
CR9
R21
R10
R4
IC1
R23
C7
C4
R18
IC2
R11
R3
R8
R22
R7
Q1
R9
R2
CR6
CR10
CR11
R19
R17
Q7
Q3
CR5

Figure 5-38. POWER SUPPLY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R3, R18, R42, R67	Res, comp, 2k ±5%, ¼w	202879	4		
R4, R19, R28, R43	Res, comp, 1M ±5%, ¼w	182204	4		
R6, R21, R30, R45	Res, comp, 1k ±5%, ¼w	148023	4		
R7, R31	Res, comp, 1.5k ±5%, ¼w	148031	2		
R8, R32, R46, R68	Res, comp, 10k ±5%, ¼w	148106	4		
R9, R33	Res, met flm, 1.74k ±1%, ½w	245647	2		
R10, R24, R34, R49, R65	Res, var, cer met, 200Ω ±20%, ½w	226050	5		
R11, R25, R35, R50	Res, met flm, 976Ω ±1%, ½w	246157	4		
R12, R36, R51	Res, comp, 560Ω ±5%, ¼w	147991	3		
R13, R37	Res, comp, 51Ω ±5%, ¼w	221879	2		
R14, R15, R38, R39, R53, R54 R55	Res, ww, 1.2Ω ±5%, 2w	248658	7		
R16, R40, R57	Res, comp, 1.2k ±5%, ¼w	190371	3		
R22, R47, R58	Res, comp, 750Ω ±5%, ¼w	218024	3		
R23, R48	Res, met flm, 866Ω ±1%, ½w	151233	2		
R52	Res, comp, 120Ω ±5%, ¼w	170712	1		
R59	Res, comp, 2.7k ±5%, ¼w	170720	1		
R60	Res, met flm, 6.34k ±1%, ½w	218636	1		
R61	Res, met flm, 6.04k ±1%, ½w	162586	1		
R62	Res, comp, 470Ω ±5%, ¼w	147983	1		
R63	Res, comp, 820Ω ±5%, ¼w	148015	1		
R64	Res, met flm, 348Ω ±1%, ½w	245761	1		
R66	Res, met flm, 562Ω ±1%, ½w	150763	1		
	Heat sink	235572	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	2 x 10^{-9}/DAY INTERNAL FREQUENCY STANDARD (OPTION -12)				
	NOTE: The 645A-12 Option Kit, part number 285585, should be ordered for field modification of the basic Model 645A.				
	DELETE:				
A3A1	5 MHz Frequency Standard (2 x 10^{-8} per day drift rate)	283523	1		
	ADD:				
A3A1	5 MHz Frequency Standard, factory selected (1 x 10^{-9} per day drift rate)	285577	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	REMOTE CONTROL ONLY OPTION				
	DELETE:				
	RF Cable No. 1 & 23	270037	2		
	RF Cable No. 2	270025	1		
A2	Front Panel Assembly - 645A (except S1, POWER Switch 255836)				
A2A1	Front Controls PCB Assembly	265587	1		
	ADD:				
	RF Cable No. 24 (includes Rear Panel J13 connector, 222364)	270074	1		
A2	Front Panel Assembly -645A-03 Option	285734	1		
A2A1	Front Controls PCB Assembly	285726	1		
	Panel, front	285718	1		
	Handle	273110	2		
	Hole plug (replaces Rear Panel connectors, J5, J12 & J18)	170118	3		
A2A1	**FRONT CONTROLS PCB ASSEMBLY (-03 Option)**	285726	REF		
CR1 thru CR8	Diode, germanium, 80 ma, 100 piv	149187	8		
CR9	Diode, silicon, 150 ma	203323	1		
Q1 thru Q8	Tstr, silicon, PNP	215897	8		
R30 thru R37	Res, comp, 10k ±5%, ¼w	148106	8		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	DELETION OF SEARCH & SWEEP FUNCTIONS (OPTION -16)				
	DELETE:				
	RF Cable No. 1 & 23	270033	2		
	RF Cable No. 4	270017	1		
	RF Cable No. 98	205815	1		
	RF Cable No. 99	205799	1		
A4A22	Search Oscillator Mixer Module (645-4146)	263483	1		
A4A23	Search VCO Module (644-4124)	254003	1		
A2	Front Panel Assembly - Remove the following parts ONLY:				
DS2 thru DS9	Lamp, incandescent, 10v	192120	8		
XDS2 thru XDS9	Socket, lamp	193037	8		
	Access door	259192	1		
	Dial, Decade Selector	265702	1		
	Dial, Digit Interpolator	260232	1		
	Knob, Decade Selector, Digit Interpolator	158949	2		
	Knob, Mode, Sweep Time-Sec, Sweep Width	158956	3		
A2A1	Front Controls PCB Assembly - 645A	265587	1		
	ADD:				
A2A1	Front Controls PCB Assembly - 645A-05 Option	285841	1		
C15	Cap, Ta, 22 uf ±10%, 15v	182816	1		
CR9, CR21	Diode, silicon, 150 ma	203323	2		F
CR10 thru CR19	Diode, germanium, 80 ma, 100 piv	149187	10		
J5	Connector, coaxial	228866	1		
R28	Res, comp, 220Ω ±5%, ¼w	147959	1		
R29	Res, var, comp, 1k ±30%, ¼w ▷1	271528	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R38 thru R47	Res, comp, 100Ω ±10%, 1w	109363	10		
R48	Res, comp, 3.3k ±5%, ¼w	148056	1		
S1	Switch, rotary, 10 MHz Digit [1]	267799	1		
S2 thru S5	Switch, rotary, 1 kHz thru 1 MHz Digits [1]	248922	4		
S6 thru S10	Switch, rotary, 0.01 Hz thru 100 Hz Digits [1]	272724	5		
S11	Switch, rotary, ACL LEVEL [1]	273201	1		
S16	Switch, rotary, FREQUENCY SELECTION [1]	633A/RA-801	1		
	Hole plug, (replaces Rear Panel connectors J12 & J13)	170118	2		
	CHANGE:				
	Panel, Front (on A2, Front Panel) from:	252627	1		
	to:	286336	1		

[1] R29, S1 thru S11 and S16 are not furnished under the Front Controls PCB Assembly, part number 285841. Order each part separately.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	DELETION OF INTERNAL FREQUENCY STANDARD (OPTION -11)				
	NOTE: The 645A-07 Option Kit, part number 285650, should be ordered for field modification of the basic Model 645A.				
	DELETE:				
A3A1	5 MHz Frequency Standard (1 x 10^{-8} per day drift rate)	283523	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	DELETION OF 0.01 Hz FREQUENCY DECADE (OPTION -15)				
	DELETE:				
A4A36	Digit Shift Mixer Module (645-4135)	263376	1		
	RF Cable No. 112	205799	1		
	Knob, Digit, 0.01 Hz	158949	1		
	Dial, Digit, 0.01 Hz	260224	1		
A2A1	Front Controls PCB Assembly - Remove the following parts ONLY:				
CR1, CR19	Diode, germanium, 80 ma,100 piv	149187	2		
Q1	Tstr, silicon, PNP	215897	1		
R30	Res, comp, 10k ±5%, ¼w	148106	1		
R47	Res, comp, 100Ω ±5%, 1w	190652	1		
S10	Switch, rotary, 0.01 Hz Digit	272724	1		
S15	Switch, rotary, DECADE SELECTOR	248922	1		
	ADD:				
S15	Switch, rotary, DECADE SELECTOR	284018	1		
	CHANGE:				
	Dial, Decade Selector from:	265702	1		
	(on A2, Front Panel) to:	285791	1		
	Panel insert, front from:	252817	1		
	(on A2, Front Panel) to:	259853	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	DELETION OF 0.01 - 0.1 Hz FREQUENCY DECADES (OPTION -14 AND -15)				
	DELETE:				
A4A35, A4A36	Digit Shift Mixer Module (645-4135)	263376	2		
	RF Cable No. 111 & 112	205799	2		
	Knob, Digits, 0.01 & 0.1 Hz	158949	2		
	Dial, Digits, 0.01 & 0.1 Hz	260224	2		
A2A1	Front Panels PCB Assembly - Remove the following parts ONLY:				
CR1, CR2, CR18,CR19	Diode, germanium, 80 ma, 100 piv	149187	4		
Q1, Q2	Tstr, silicon, PNP	215897	2		
R30, R31	Res, comp, 10k ±5%, ¼w	148106	2		
R46, R47	Res, comp, 100Ω ±5%, 1w	190652	2		
S9, S10	Switch, rotary, 0.01 & 0.1 Hz Digits	272724	2		
S15	Switch, rotary, DECADE SELECTOR	248922	1		
	ADD:				
S15	Switch, rotary, DECADE SELECTOR	284026	1		
	CHANGE:				
	Dial, Decade Selector (on A2, Front Panel) from: to:	265702 285809	1 1		
	Panel insert, front (on A2, Front Panel) from: to:	252817 285767	1 1		

REF DESIG	DESCRIPTION		STOCK NO	TOT QTY	REC QTY	USE CODE
	DELETION OF 0.01 - 1.0 Hz FREQUENCY DECADES OPTION		645A-34			
	DELETE:					
A4A34, A4A35, A4A36	Digit Shift Mixer Module (645-4135)		263376	3		
	RF Cable No. 110, 111 & 112		205799	3		
	Knob, Digits, 0.01, 0.1 & 1 Hz		158949	3		
	Dial, Digits, 0.01, 0.1 & 1 Hz		260224	3		
A2A1	Front Controls PCB Assembly - Remove the following parts ONLY:					
CR1, CR2, CR3, CR17, CR18, CR19	Diode, germanium, 80 ma, 100 piv		149187	6		
Q1, Q2, Q3	Tstr, silicon, PNP		215897	3		
R30, R31, R32	Res, comp, 10k ±5%, ¼w		148106	3		
R45, R46, R47	Res, comp, 100Ω ±5%, 1w		190652	3		
S8, S9, S10	Switch, rotary, 0.01, 0.1, & 1 Hz Digits		272724	3		
S15	Switch, rotary, DECADE SELECTOR		248922	1		
	ADD:					
S15	Switch rotary, DECADE SELECTOR		284034	1		
	CHANGE:					
	Dial, Decade Selector	from:	265702	1		
	(on A2, Front Panel)	to:	285817	1		
	Panel insert, front	from:	252817	1		
	(on A2, Front Panel)	to:	246812	1		

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
101774	72653	1712-C
105692	71590	2DDH60N501K
106088	56289	192P12292
106203	72982	8001000X5R-0561K
106211	72982	851000Z5U0272P
106732	71590	CF122
106906	56289	150D106X0006B2
108506	01121	EB2225
109272	71400	Type MDL
109322	71400	Type MDL
109363	01121	GB1011
113191	80294	275-1-202
115311	01121	BB6811
116111	05277	1N4817
122333	11537	2767
147819	72259	WEE1000
147827	72259	WEE470
147843	72259	WEE22
147868	01121	CB1005
147876	01121	CB1505
147884	01121	CB2205
147892	01121	CB4705
147900	01121	CB5605
147918	01121	CB6805
147926	01121	CB1015
147934	01121	CB1515
147942	01121	CB1815
147959	01121	CB2215
147967	01121	CB3315
147983	01121	CB4715
147991	01121	CB5615

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
148007	01121	CB6815
148015	01121	CB8215
148023	01121	CB1025
148031	01121	CB1525
148049	01121	CB2225
148056	01121	CB3325
148064	01121	CB3925
148072	01121	CB4725
148080	01121	CB5625
148098	01121	CB6825
148106	01121	CB1035
148114	01121	CB1535
148130	01121	CB2235
148148	01121	CB2735
148155	01121	CB3335
148163	01121	CB4735
148171	01121	CB6835
148320	14655	CD19F332J
148346	14655	CD19F222J
148353	14655	CD19F182J
148361	14655	CD19F152J
148387	14655	CD19F102J
148395	14655	CD19F821J
148411	14655	CD19F511J
148429	14655	CD19F471J
148437	14655	CD15F391J
148445	14655	CD15F331J
148452	14655	CD15F271J
148460	14655	CD15F181J
148478	14655	CD15F151J
148486	14655	CD15F121J

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
148494	14655	CD15F101J
148502	14655	CD15F820J
148510	14655	CD15F680J
148528	14655	CD15F560J
148536	14655	CD15E470J
148544	14655	CD15E390J
148551	14655	CD15E220J
148569	84171	DM15C150J
148577	14655	CD15C050K
148593	01295	2N706A
148668	91506	8000AG10
149153	56289	C023B101F103M
149161	56289	55C23A1
149187	93332	1N270
149484	01121	CB8205
150763	91637	Type MFF ½
151233	91637	Type MFF ½
152033	02660	U61094A/U
153031	71744	Type 381
153049	73899	5284
153056	56289	150D156X9020B2
153916	01121	BB1021
153924	01121	BB1511
153932	01121	BB1521
153965	01121	BB2221
153981	01121	BB4711
153999	01121	BB8211
158949	89536	158949
158956	89536	158956
159731	01121	CB1235

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
160259	56289	150D106X9020A2
160317	14655	CD15E330J
160796	01121	CB8225
160804	01121	CB2715
160812	01121	CB2705
160846	75915	342004
160937	01121	CB2245
161331	56289	196D224X-0035
161919	56289	196D105X0035
161927	56289	196D225X0020
161992	73445	C280AEA100K
162008	73445	C280AEA47K
162156	12617	DRR-1
162347	89536	162347
162586	91637	Type MFF ½
166306	71400	Type MDL
168195	91637	Type MFF 1/8
168211	91637	Type MFF 1/8
168229	91637	Type MFF 1/8
168245	91637	Type MFF 1/8
168260	91637	Type MFF 1/8
168385	84171	PE103G
168450	14655	DMF2S1
168708	03508	2N3391
170118	72653	1711-C
170415	14655	CD15F111F
170423	14655	CD15F221J
170431	14655	CD19F561J
170456	05397	K100C10K
170712	01121	CB1215

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
170720	01121	CB2725
172148	03877	1N3496
172890	89536	172890
172940	89536	172940
172965	89536	172965
172973	89536	172973
172981	89536	172981
173112	89536	173112
173773	89536	173773
174276	89536	174276
174714	72259	WEE3.3
174722	72259	WEE4.7
174730	72259	WEE10
175034	01121	CB3305
175042	01121	CB1825
175208	84171	DM15020K
175216	14655	CD15C0100K
175224	14655	CD15E120J
175232	56289	C023B101E502M
177980	14655	CD15F431J
177998	14655	CD15E270J
178814	12856	Tuning Tool A
179077	56289	5C023684D8250B3
179374	04713	2N2218
180455	07910	1N749A
181156	89536	181156
181164	89536	181164
182204	01121	CB1055
182212	01121	CB1545
182279	01121	CB33G5

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
182816	56289	150D226X9015A2
182824	56289	150D686X9015R2
182873	14655	CD19F562G
182956	91637	Type MFF 1/8
186155	71707	SP-24-P
187765	73445	C437ARE250
187765	73445	ET331X016A00*
188458	01121	CB8235
188920	01281	V754 & V754C
190371	01121	CB1225
190397	14655	CD15C040K
190652	01121	GB1015
192120	08806	709
192567	03508	C6F
192948	01121	CB3345
193011	56289	150D337X9006S2
193037	95263	25-08-1
193052	19701	ET50W101
193342	01121	CB5135
193359	01121	CB47G5
193367	01121	CB4335
193375	01121	CB4325
193417	01121	CB3035
193441	01121	CB1845
193458	01121	CB1245
193474	01121	CB1115
193482	01121	CB2015
193508	01121	CB3025
193623	56289	196D106X-0015
194803	73445	C280AEA220K
194944	01121	CB1065

*Direct Replacement For 187765 (Ref: Amperex New ET Series)

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
195974	04713	2N3906
202879	01121	CB2025
203323	03508	DHD1105
203489	07910	CDQ10656
203802	19701	ET50X203
203810	19701	ET50X503
203828	19701	ET50X201
203836	19701	ET50X102
203869	01121	CB4315
204958	89536	204958
205757	89536	205757
205765	89536	205765
205773	89536	205773
205781	89536	205781
205799	89536	205799
205815	89536	205815
205823	89536	205823
205849	89536	205849
205856	89536	205856
205872	89536	205872
205898	89536	205898
205906	89536	205906
205930	89536	205930
205955	89536	205955
207076	89536	207076
207084	89536	207084
207092	89536	207092
207100	89536	207100
207118	89536	207118

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
207126	89536	207126
207589	72259	WEE1.0
207639	98291	51-049-0000
208033	01121	CB56G5
208330	19701	ET50X202
208983	14655	CD19F751J
215301	98291	51-046-0000
215897	04713	2N4126
216549	91836	KC7947
216986	14655	CD15C080K
218024	01121	CB7515
218396	04713	2N3904
218636	91637	Type MFF ½
219097	15898	765972
219535	02114	56-060-85-3B
220541	01121	CB8245
221606	01121	CB1635
221671	91637	Type MFF 1/8
221879	01121	CB5105
221903	01121	CB6215
222364	00779	2-330060-2
222604	87034	SW616-27
223537	91637	Type MFF 1/8
223586	91637	Type MFF 1/8
224782	89536	224782
225599	07263	S22650
226027	88486	PWC SPEC C-256-01
226050	19701	ET50W201
226076	19701	ET50W202
226084	19701	ET50W502

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
226100	70903	17258
226142	14655	CD15F331F
226126	14655	CD15F101F
226134	14655	CD15F151F
226159	14655	CD19F681F
226209	91637	Type MFF 1/8
226217	91637	Type MFF 1/8
226274	82389	46256-LF
226290	04713	MPS3640
228866	00779	50095-1
229146	91637	Type MFF 1/8
229930	91293	JMC2951
229948	72982	538-006B-7-25
229989	71707	U-12-P
230037	89536	230037
234054	03508	2N3405
234450	07910	CD9049
235135	91637	Type MFF 1/8
235143	91637	Type MFF 1/8
235333	91637	Type MFF 1/8
235572	89536	235572
236547	04713	MDA960-3
236828	91637	Type MFF 1/8
236901*	73445	C437ARF160
236901	73445	ET151X025A6*
236935 **	73445	C426ARD200
236935	73445	ET221X010A5**
237230	91637	Type MFF 1/8
240473	89536	240473
241018	89536	241018
241703	19701	ET50X502
242016	11726	QD401-78E
245647	91637	Type MFF 1/2

*Replacement For 236901 (Ref: Amperex New ET Series)

**Replacement For 236935 (Ref: Amperex New ET Series)

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
245761	91637	Type MFF ½
246157	91637	Type MFF ½
246256	95303	CA3028A
246264	95303	2N3933
246306	89536	246306
246603	04713	MC170CG
246812	89536	246812
246959	01121	BB1021
246967	01121	BB6821
246975	01121	BB1031
248047	72259	WEE0.47
248211	91293	JMC5601
248286	00656	Type BSF-1BB
248294	28480	5082-0114
248351	04713	MPS918
248385	56289	150D157X9015S2
248641	91637	Type MFF 1/8
248658	75042	Type BWH
248666	56289	39D218G040JP0
248765	75042	151-1873-5K
248773	95303	CA3033
248781	01121	CB2045
248807	91637	Type MFF 1/8
248864	95303	CA3019
248880	95303	CA3018
248898	12040	LM201
248922	89536	248922
248955	89536	248955
248963	89536	248963
248971	89536	248971
249003	71590	TCN56

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
249011	89536	249011
249078	24759	MR10
252544	89536	252544
252551	89536	252551
252569	89536	252569
252577	89536	252577
252585	89536	252585
252593	89536	252593
252627	89536	252627
252643	89536	252643
252684	89536	252684
252817	89536	252817
252908	89536	252908
252916	89536	252916
252924	89536	252924
252932	89536	252932
252940	89536	252940
252957	89536	252957
252965	89536	252965
252973	89536	252973
252999	89536	252999
253013	89536	253013
253021	89536	253021
253039	89536	253039
253047	89536	253047
253054	89536	253054
253062	89536	253062
253112	89536	253112
253120	89536	253120
253278	89536	253278
253286	89536	253286

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
253294	89536	253294
253302	89536	253302
253310	89536	253310
253336	89536	253336
253344	89536	253344
253369	89536	253369
253377	89536	253377
253385	89536	253385
253427	89536	253427
253591	89536	253591
253658	89536	253658
253690	89536	253690
254003	89536	254003
254045	89536	254045
254136	89536	1803-254136
254201	89536	254201
254219	89536	254219
254490	89536	254490
254508	89536	254508
255406	89536	255406
255471	72982	8121-050-651-502M
255489	80294	3292P1202
255497	91637	IDH1041-19
255505	91637	IDH1041-11
255513	91637	IDH1042-9
255521	91637	IDH1042-10
255836	87034	54-62081-27
255893	73293	EMS068DJ000
255919	91637	Type IDH1041
255927	71450	H17-019-0589

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
256115	24759	MR-470
256289	72259	WEE0-12
256339	28480	5082-2900
256347	01121	Type SH
256354	01121	Type SH
256560	89536	256560
256578	89536	256578
257154	24759	MR0.10
257170	01295	2N3571
259192	89536	259192
259317	89536	259317
259622	89536	259622
259754	89536	259754
259853	89536	259853
259861	89536	259861
260224	89536	260224
260232	89536	260232
260638	25403	A485
261198	05245	2A-1 series
261396	89536	261396
261735	24759	MR0.22
261750	01121	Type SH
261768	01121	Type SH
261784	01121	Type SH
261800	01121	BB1501
261818	01121	BB6801
261826	01121	BB1011
261834	01121	BB2711
261842	01121	CB6205
261883	91637	Type MFF 1/8
263137	89536	263137
263145	89536	263145

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
263152	89536	263152
263160	89536	263160
263178	89536	263178
263186	89536	263186
263194	89536	263194
263202	89536	263202
263210	89536	263210
263236	89536	263236
263244	89536	263244
263251	89536	263251
263269	89536	263269
263277	89536	263277
263285	89536	263285
263293	89536	263293
263301	89536	263301
263319	89536	263319
263327	89536	263327
263335	89536	263335
263350	89536	263350
263376	89536	263376
263384	89536	263384
263392	89536	263392
263400	89536	263400
263418	89536	263418
263434	89536	263434
263442	89536	263442
263475	89536	263475
263483	89536	263483
263517	89536	263517
263657	89536	263657

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
263665	89536	263665
263673	89536	263673
263681	89536	263681
263699	89536	263699
263707	89536	263707
263715	89536	263715
263723	89536	263723
263731	89536	263731
263749	89536	263749
263736	89536	263756
263772 *	89536	263772 *
263780 *	89536	263780 *
263798 *	89536	263798 *
263863	89536	263863
263947	89536	263947
263954	89536	263954
263962	89536	263962
263970	89536	263970
263988	89536	236988
263996	89536	263996
264002	89536	264002
264010	89536	264010
264028	89536	264028
264036	89536	264036
264101	89536	264101
264119	89536	264119
264127	89536	264127
264135	89536	264135
264143	89536	264143
264150	89536	264150
264168	89536	264168
264176	89536	264176

*Must be special ordered.

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
264184	89536	264184
264200	89536	264200
264218	89536	264218
264226	89536	264226
264234	89536	264234
264242	89356	264242
264259	89536	264259
264267	89536	264267
264275	89536	264275
264309	89536	264309
264325	89536	264325
264333	89536	264333
264341	89536	264341
264358	89536	264358
264366	89536	264366
264374	89536	264374
264382	89536	264382
264390	89536	264390
264416	89536	264416
264424	89536	264424
264440	89536	264440
264507	89536	264507
264796	89536	264796
264879	89536	264879
264887	89536	264887
264895	89536	264895
264903	89536	264903
264911	89536	264911
264929	89536	264929
264937	89536	264937
264945	89536	264945

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
264952	89536	264952
265199	89536	265199
265520	89536	265520
265587	89536	265587
265603	89536	265603
265611	89536	265611
265629	89536	265629
265702	89536	265702
265751	89536	265751
265769	89536	265769
265777	89536	265777
265785	89536	265785
265793	89536	265793
265801	89536	265801
265819	89536	265819
265827	89536	265827
266007	27956	Type M6E-4
266205	14655	CD15F131
266239	01121	BB2721
266247	01121	BB8201
266254	01121	BB2701
266262	01121	BB5101
266411	95303	3N141
266429	01121	FW5N2711
266437	01121	FW5N102W
266585	14655	CD15C180J
266593	14655	CD15F680F
267260	93332	SF123-03
267278	04713	MC1027L
267377	01121	BB3921

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
267740	91637	Type MFF 1/8
267757	21455	PL 1615-4
267765	95303	3N140
267781	89536	267781
267799	89536	267799
268003	56289	34D258G015HP0
268029	56289	39D957G015HE4
268250	95303	2N5035
268748	11882	TBA340-6.48AB1
268755	11882	TBP380-7.6-6AB1
268763	11882	TBP415-14.5-8AB1
268961	12040	SL6267
269027	91637	Type IDH1042
269035	91637	Type IDH1041
269043	91637	Type IDH1041
269423	89536	269423
269506	89536	269506
269514	89536	269514
269522	89536	269522
269530	89536	269530
269548	89536	269548
269555	89536	269555
269936	89536	269936
269944	89536	269944
269951	89536	269951
269969	89536	269969
269977	89536	269977
269985	89536	269985

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
270009	89536	270009
270017	89536	270017
270025	89536	270025
270033	89536	270033
270041	89536	270041
270058	89536	270058
270074	89536	270074
270082	89536	270082
270090	89536	270090
270108	89536	270108
270116	89536	270116
270124	89536	270124
270132	89536	270132
270140	89536	270140
270157	89536	270157
270165	89536	270165
270173	89536	270173
270181	89536	270181
270199	89536	270199
270207	89536	270207
270215	89536	270215
270223	89536	270223
270231	89536	270231
270249	89536	270249
270256	89536	270256
270264	89536	270264
270272	89536	270272
270280	89536	270280
270306	89536	270306

MANUFACTURERS' CROSS REFERENCE LIST		
FLUKE STOCK NO.	MFR.	MFR. PART NO.
270314	89536	270314
270322	89536	270322
270330	89536	270330
270348	89536	270348
270355	89536	270355
270363	89536	270363
270371	89536	270371
270389	89536	270389
270413	89536	270413
270421	89536	270421
271346	91637	Type MFF 1/8
271379	01121	BB3021
271502	12040	LM301A
271528	71450	UM5788
271957	14655	CD15F820F
271999	84411	X662FR47492
272302	98291	52-046-0000
272484	72982	301000C0J0229C
272492	72982	301000C0J0339C
272500	72982	301000C0H0509C
272518	72982	301000C0H0689C
272617	24759	MRO.12
272724	89536	272724
272757	04713	1N2970
272880	14655	CD15F201J
272930	04713	2N5943
273110	89536	273110
273201	89536	273201
273680	89536	273680
273904	89536	273904
273912	89536	273912
273920	89536	273920

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
273938	89536	273938
273946	89536	273946
274530	89536	274530
274548	89536	274548
274811	89536	274811
274829	89536	274829
274852	89536	274852
274993	89536	274993
275008	89536	275008
275016	89536	275016
275024	89536	275024
275453	73245	WSS0132P03BN500
275461	73293	WSS0132S00BN000
275479	73293	WP22Y22C000
275529	00656	Type 4420
275537	00656	Type 4420
275545	00656	Type 4420
276444	06001	69F930G3
276469	14655	CD15F620J
276527	23880	TSA-2900-14w
276857	01295	SN74141N
277152	71744	26F919
277202	14655	CD15E430F
277582	89536	277582
279836	89536	279836
280594	89536	280594
280842	89536	280842
282707	89536	282707
282731	89536	282731
282756	89536	282756
283523	89536	283523

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
284018	89536	284018
284026	89536	284026
284034	89536	284034
284042	89536	284042
284059	89536	284059
284133	73245	J273-132P
284638	24355	Model 903
284778	14655	CD15F191F
284786	14655	CD15F181F
284794	14655	CD15F200F
285577	89536	285577
285585	89536	285585
285601	89536	285601
285627	89536	285627
285643	89536	285643
285650	89536	285650
285668	89536	285668
285676	89536	282676
285684	89536	285684
282692	89536	285692
285718	89536	285718
285726	89536	285726
285734	89536	285734
285767	89536	285767
285775	89536	285775
285791	89536	285791
285809	89536	285809
285817	89536	285817
285825	89536	285825
285833	89536	285833
285841	89536	285841
285965	89536	285965
285973	89536	285973
286336	89536	286336
286690	89536	286690
633A/RA-801	89536	633A/RA-801

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
273938	89536	273938
273946	89536	273946
274530	89536	274530
274548	89536	274548
274811	89536	274811
274829	89536	274829
274852	89536	274852
274993	89536	274993
275008	89536	275008
275016	89536	275016
275024	89536	275024
275453	73245	WSS0132P03BN500
275461	73293	WSS0132S00BN000
275479	73293	WP22Y22C000
275529	00656	Type 4420
175537	00656	Type 4420
275545	00656	Type 4420
276444	060G1	69F930G3
276469	14655	CD15F620J
276527	23880	TSA-2900-14w
276857	01295	SN74141N
277152	71744	26F919
277202	14655	CD15E430F
277582	89536	277582
279836	89536	279836
280594	89536	280594
280842	89536	280842
282707	89536	282707
282731	89536	282731
282756	89536	282756
283523	89536	283523

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
284018	89536	284018
284026	89536	284026
284034	89536	284034
284042	89536	284042
284059	89536	284059
284638	24355	Model 903
285577	89536	285577
285585	89536	285585
285601	89536	285601
285619	89536	285619
285627	89536	285627
285643	89536	285643
285650	89536	285650
285668	89536	285668
285676	89536	282676
285684	89536	285684
282692	89536	285692
285718	89536	285718
285726	89536	285726
285734	89536	285734
285767	89536	285767
285775	89536	285775
285791	89536	285791
285809	89536	285809
285817	89536	285817
285825	89536	285825
285833	89536	285833
285841	89536	285841
285965	89536	285965
285973	89536	285973
286336	89536	286336
286690	89536	286690
633A/RA-801	89536	633A/RA-801

SECTION 6

Accessory & Option Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. ACCESSORY INFORMATION

6-4. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

6-5. OPTION INFORMATION

6-6. Each of the options available for this instrument, if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and field installation procedures. A complete list of replaceable parts for each option is contained at the end of that option description.

ACCESSORY INFORMATION

MODEL A607 BCD TO DECIMAL CONVERTER

6-1. INTRODUCTION

6-2. The Model A607 BCD to Decimal Converter allows the remote control features of the Model 645A Frequency Synthesizer to be programmed with low level 8-4-2-1 binary coded information. Input and output logic levels are as follows:

INPUTS

Logic "0" (false) . .	Input of 0 to 0.8 vdc at a maximum current of –4 ma.
Logic "1" (true) . .	Input of 2 to 5 vdc at a maximum input current of 1 ma.

OUTPUT LEVELS

False	Output voltage of 0 vdc at 2.2K to ground.
True	Minimum output voltage of +11.5 vdc at a maximum current of 30 ma.

6-3. The BCD to Decimal Converter circuitry is completly solid-state and is contained within a 3½ inch by 17 inch by 22 inch chassis. Circuit interface between the remote programming equipment and the Model A607 is accomplished using the mating connector furnished in the Model 645A Accessory Kit. An OUTPUT cable on the Model A607 mates directly to the synthesizer REMOTE INPUT connector. Input power requirements are 115 or 230 vac at 50 to 400 Hz and ±12 vdc. The ac power is obtained from an available ac line and the ±12 vdc operating voltage is obtained from the synthesizer through the OUTPUT cable interface.

6-4. INPUT POWER

6-5. The Model A607 can be operated from either a 115 or 230 vac power source. A slide switch on the rear panel provides rapid conversion to either power line voltage. A ¼ ampere SLO-BLO fuse is initially installed at the factory and is adequate for operation from a 115 vac power line. If the instrument is operated from a 230 vac power line, replace the fuse with a 1/8 ampere SLO-BLO.

6-6. RACK INSTALLATION

6-7. The Model A607 is designed for bench-top use or installation in a standard 19 inch electronic equipment rack. Resilient feet have been installed on the bottom dust cover to allow bench-top use. The chassis is drilled to accept chassis slides and Fluke rack mounting brackets. To install the instrument in an electronic equipment rack, proceed as follows:

a. Peel the decals from the front side panels and install the rack mounting brackets.

b. Slide the plastic side strips from the middle side panels and install the chassis slides.

c. Install the Model A607 in the electronic equipment rack.

6-8. OPERATING PROCEDURES

6-9. Remote programming of the synthesizer output frequency, search decade selection, and output level mode is possible using the Model A607. Input coding requirements are given in Tables 1 and 2 of the Model A607 Schematic Diagram, Drawing No. 607A-1003. Terminal information for the INPUT and OUTPUT connectors is also contained on the same diagram. To remotely program the synthesizer using the Model A607, proceed as follows:

a. Connect the power cord to the available line power receptacle.

CAUTION!

Ensure that the round pin on the three-prong power cord plug is connected to a high quality earth ground.

b. Connect the Model A607 OUTPUT cable to the REMOTE INPUT connector on the synthesizer.

c. Perform the necessary circuit connections between the programming equipment and the mating connector furnished with the synthesizer. Refer to the Model A607 Schematic Diagram, Drawing No. 607A-1003, for location and function of the INPUT connector terminals.

d. Connect the mating connector to the INPUT connector of the Model A607 and then press the POWER switch. The POWER switch will be illuminated when the Model A607 is energized.

e. Place the Model 645A controls as follows:

FREQUENCY SELECTION	REMOTE
DECADE SELECTOR	REMote
OUTPUT	1V RMS

NOTE!

The local and remote OUTPUT modes are not mutually exclusive and will interact. Remote operation is possible only when the OUTPUT control is set to 1V RMS. For local operation, a remote 1 V RMS command must also exist.

6-10. Programming commands from the remote control equipment are now controlling the various functions of the synthesizer.

NOTE!

Program input codes must not exceed the maximum decimal number of that decade.

6-11. THEORY OF OPERATION

6-12. The circuitry contained in the Model A607 consists of a Power Supply, a Mother Board, two BCD to Decimal Decoders, and a Decoder assembly. A Schematic Diagram, Drawing No. 607A-1003 is located at the rear of this section.

6-13. Power Supply

6-14. Power transformer T1 receives ac power through the fuse F1, which protects the circuitry from overloads. The primary of T1 consists of two windings, which, when properly connected by S2, allow operation from either a 115 or 230 volt ac power line. Series connection is used for 115 volt line operation and parallel connection is used for 230 volt line operation. The primary of T1 applies the required ac voltage to the Power Supply, which, in turn produces the +5 vdc operating voltage for the two BCD to Decimal Decoders and the Decoder assemblies. The secondary of T1 provides an operating voltage for the PWR switch, S1.

6-15. Mother Board (605A-4002)

6-16. The Mother Board contains two power relays which apply +5 vdc operating voltages to the BCD to Decimal Decoders and Decoder assemblies. The relays are independently or simultaneously energized with +12 vdc remote commands from the FREQUENCY SELECTION and DECADE SELECTOR controls of the synthesizer. Plus and minus 12 vdc operating voltages from the synthesizer are also distributed through this assembly to the BCD Decoders and Decoder assemblies and the INPUT connector.

6-17. BCD to Decimal Decoder (A605-4001)

6-18. Two identical BCD to Decimal Decoder assemblies are contained in the Model A607. Each assembly consists of five separate integrated circuit BCD decoders and fifty output transistor drivers. Four line binary coded inputs are converted to decimal information by the integrated circuit BCD decoders. The associated transistor drivers produce the +12 vdc decimal outputs, which are applied through the OUTPUT cable to the REMOTE INPUT connector of the synthesizer.

6-19. Decoder (A607-4001)

6-20. The Decoder assembly contains a single integrated circuit BCD decoder and ten associated transistor drivers and the remote OUTPUT level control circuitry. The BCD decoder and associated transistor drivers control the .01 Hz frequency decade and operate in the same manner as those described in paragraph 6-18. The OUTPUT level control circuitry consists of two separate two-stage drivers. Transistors Q2 and Q3 are used to activate the ALC feature and Q4 and Q5 activate the EXT AM feature. Since both circuits operate in the same manner, only the ALC control circuit is described.

6-21. Diodes CR1 through CR3 form the input biasing network of a typical DTL gate. The presence of a logic "1" input at CR1 turns the diode off and results in the conduction of CR2 and CR3. Transistor Q2 and Q3 are switched into conduction by this condition and a +12 vdc remote ALC gate command is generated at the collector of Q3. When a logic "0" input is applied to CR1, the diode conducts and clamps the junction of R8 and CR2 at near ground potential. This condition turns off CR2, CR3, Q3, and Q4 and produces a zero volt output at the collector of Q4.

6-22. MAINTENANCE

6-23. There are no adjustments in the Model A607. However, correct operation can be verified using the following procedure:

a. Perform the operations contained in paragraph 6-8.

b. Connect a frequency counter and an rf voltmeter to the 50 Hz - 50 MHz OUTPUT on the synthesizer. Ensure that this output is terminated into a 50-ohm load.

c. Program the remote control equipment through all frequency digits, observing that the correct output frequencies are obtained. The rf voltmeter should indicate a 1.0 volt rms output level for each programmed output frequency.

d. Program the remote control equipment to select each search decade, observing that the correct decade is selected.

e. Remove the top dust cover from the Model A607 and measure the collector voltage at several random selected transistor drivers. The "ON" voltage should be greater than +11.5 volts dc and the "OFF" voltage should be less than 0 volts dc.

f. Replace the top dust cover.

g. Program the remote control equipment to select the EXT AM output level feature. With no signal applied to the synthesizer EXTERNAL MODULATION INPUT connector, the rf voltmeter should indicate a 0.67 volt rms output level.

h. Program the remote control equipment to select the ALC output function. The synthesizer output level should be adjustable from 0.2 to 1.1 volts rms with the ALC LEVEL control.

6-24. PARTS LIST

6-25. The following illustrated parts list contains all the electrical components that are part of the Model A607. Column entries and part ordering information is given in Section V of the manual.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	A607 BCD TO DECIMAL CONVERTER	286047			
	Front Panel Assembly		1		
	Rear Panel Assembly		1		
	Mother Board PCB Assembly (605A-4002)	282731	1		
	BCD Decoder PCB Assembly (605A-4001)	282707	2		
	BCD Decoder PCB Assembly (607A-4001)	282756	1		
T1	Transformer, power	122333	1		
	Power Supply	284638	1		
	Cover, Bottom	254508	1		
	Cover, Top	254490	1		
	Foot	230037	4		
	FRONT PANEL ASSEMBLY				
DS1	Lamp, incandescent, 6.3v	153031	1		
S1	Switch, push button, spdt	222604	1		
	Panel, front	285965	1		
	Handle	246306	2		
	REAR PANEL ASSEMBLY				
F1	Fuse, ¼ amp, slo-blo, 250v	166306	1		
J1	Connector, Input, female, 132 contact	275461	1		
J2	Connector, Output, male, 132 contact	275453	1		
S2	Switch, slide, dpdt, line voltage	226274	1		
W1	Line cord	226027	1		
XF1	Fuse holder	160846	1		
	Panel, rear	285973	1		
	MOTHER BOARD PCB ASSEMBLY (605A-4002)	282731	REF		
K1	Reed switch	162156	1		
	Coil, reed switch	186155	1		
K2	Reed switch	219097	1		
	Coil, reed switch	229989	1		
R4	Res, comp, 330Ω ±5%, ¼w	205534	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	BCD DECODER PCB ASSEMBLY (605A-4001)	282707	REF		
IC1	IC, BCD Decoder	278657	5	1	
Q1	Tstr, silicon, PNP	215897	50	2	
R1	Res, comp, 1.5k ±10%, 1/8w	153932	50		
R2	Res, comp, 3k ±10%, 1/8w	271379	50		
R3	Res, comp, 2.2k ±10%, 1/8w	153965	50		
	BCD DECODER PCB ASSEMBLY (607A-4001)	282756	REF		
CR1 thru CR6	Diode, silicon, 150 ma	203323	6	1	
IC1	IC, BCD Decoder	276857	1	1	
Q1 thru Q4	Tstr, silicon, NPN	218396	4	1	
Q5 thru Q14	Tstr, silicon, PNP	215897	10	1	
R1, R6	Res, comp, 2.2k ±5%, ¼w	148049	2		
R2, R7	Res, comp, 4.3k ±5%, ¼w	193375	2		
R3, R8	Res, comp, 3.9k ±5%, ¼w	148064	2		
R4, R5, R9, R10	Res, comp, 10k ±5%, ¼w	148106	4		
R11 thru R20	Res, comp, 3k ±10%, 1/8w	271379	10		
R21 thru R30	Res, comp, 1.5k ±10%, 1/8w	153932	10		
R31 thru R40	Res, comp, 2.2k ±10%, 1/8w	153965	10		

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations
Federal Supply Codes for Manufacturers
Fluke Technical Service Centers — U.S. and Canada
Sales and Service Locations — International
Sales Representatives — U.S. and Canada

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal (seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch (es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(−) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers (Continued)

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

Federal Supply Codes for Manufacturers (Continued)

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

Federal Supply Codes for Manufacturers (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
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79497
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80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
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80183 - use 56289
Sprague Products
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80294
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83003
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83058
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83298
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86684
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91293
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91407
Replaced by 58474

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91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
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91662
Elco Corp.
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91737 - use 71468
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91934
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Alpha Wire Corp.
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93332
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94145
Replaced by 49956

94154 - use 94988
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95263
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Replaced by 98278

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Replaced by 11358

98094
Replaced by 49956

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98278
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98291
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98388
Royal Industries
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San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
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Chicago, Illinois

99217
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99392
STM
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99515
ITT Jennings Monrovia Plant
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Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
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ACCESSORY INFORMATION

THE –17 OPTIONAL 1 – 5 MHz MULTIPLIER

6-1. INTRODUCTION

6-2. The Model 645A can be driven from an external 1 MHz frequency standard upon installation of the 1 to 5 MHz Multiplier Module. Signal level requirement is 1.0 volt rms ±3 db into 50 ohms.

6-3. OPERATING PROCEDURES

6-4. Operation of the synthesizer using a 1 MHz drive source involves applying the drive source to the SYNTHESIZER INPUT connector on the rear panel. Applicable operating instructions are the same as those contained in Section II.

6-5. THEORY OF OPERATION

6-6. Introduction

6-7. The 1-5 MHz Multiplier Module (644-4144) receives a 1 MHz standard frequency input signal, multiplies the signal by five, and provides a single 5 MHz output signal. Circuitry of the module consists of an integrated circuit X5 multiplier and an emitter-follower output circuit. The Schematic Diagram, Drawing No. 645-1044, is located at the rear of this section.

6-8. Circuit Description

6-9. The 1 MHz input signal present at J1 is coupled by C1 to pin 1 of IC1. Integrated circuit IC1 is a balanced differential amplifier configured as a X5 multiplier. The tuned circuit comprised of L2 and C3 selects the fifth harmonic 5 MHz output of IC1, which is then applied to Q1. Emitter-follower Q1 provides the necessary impedance match and power gain of the 5 MHz signal applied to the module output connector J2.

6-10. ALIGNMENT PROCEDURE

6-11. Alignment of this module requires the following equipment:

a. +12 volt dc regulated power supply.

b. Signal Generator (1 MHz at one volt rms).

c. RF Voltmeter.

d. Frequency Counter.

e. 50-ohm load.

6-12. Adjustment, transistor, and integrated circuit locations are illustrated in Figure 6-1. To align the module, perform the following steps:

a. Remove the screws from the enclosure cover and remove the cover from the module.

b. Apply +12 volts dc and ground to the appropriate feed-thru terminals on the module.

c. Connect the 50-ohm load and rf voltmeter input to J2.

d. Apply a 1 MHz signal having a level of one volt rms, ±3 db, to J1.

e. Adjust L2 for maximum rms voltage at J2. Minimum acceptable rms voltage is 0.5 volt rms.

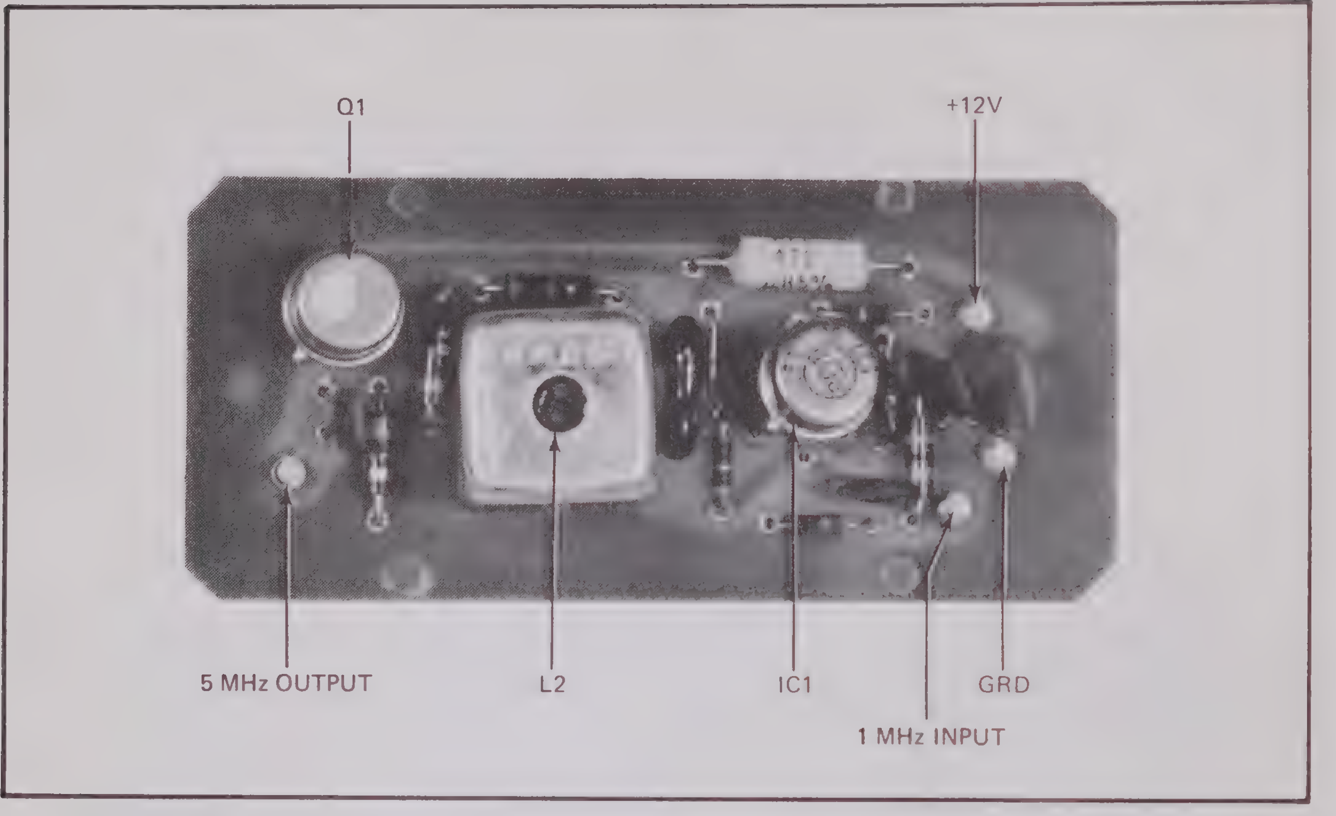


Figure 6-1. ADJUSTMENT, TRANSISTOR, AND INTEGRATED CIRCUIT LOCATIONS

f. Connect the frequency counter input to J2, observing that a 5 MHz output signal is present.

g. Disconnect the test equipment from the module and replace the enclosure cover.

6-13. PARTS LIST

6-14. The following illustrated parts list contains all the electrical components that are part of the 1–5 MHz Multiplier Module. Additional information regarding column entries and ordering of parts can be found in Section V of the manual.

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	1-5 MHz INPUT FREQUENCY MULTIPLIER (OPTION -17)				
	NOTE:				
	The 645A-17 Option Kit, part number 285643, should be ordered for field modification of the basic Model 645A.				
	ADD:				
A3A12	1-5 MHz MULTIPLIER MODULE (644-4144) (See Figure 6-2)	253344	1		
	RF Cable No. 25 & 26 (Includes Rear Panel connectors J10 & J11 respectively, P/N 222364)	286690	2		
A3A12	1-5 MHz MULTIPLIER MODULE (644-4144)	253344	REF		
A1	1-5 MHz Multiplier PCB Assembly (See Figure 6-2)	253336	1		
J1, J2	Connector, female, BNC, coaxial	152033	2		
	Cap, feed-thru, 2500 pf gmv	248286	1		
	Connector, male, coaxial	207639	1		
	Cover, module	259317	1		
	Enclosure, module (Indicate 644-4144 when ordering)	259861	1		
A1	1-5 MHz MULTIPLIER PCB ASSEMBLY Figure 6-2	253336	REF		
C1, C4, C5	Cap, cer, 0.005 uf, gmv, 25v	255471	3		
C2	Cap, cer, 0.01 uf ±20%, 100v	149153	1		
C3	Cap, mica, 220 pf ± 5%, 500 v	170423	1		
IC1	IC, balanced differential amplifier	246256	1		
L1	Inductor, 470 uh, 58 ma	256115	1		
L2	Inductor, variable	253591	1		
Q1	Tstr, silicon, NPN	179374	1		
R1	Res, comp, 56Ω ±5%, ¼w	147900	1		
R2, R5	Res, comp, 2k ±10%, 1/8w	246959	2		
R3, R4	Res, comp, 1k ±10%, 1/8w	153916	2		
R6	Res, comp, 1k ±5%, ¼w	148023	1		
R7	Res, comp, 3.3k ±5%, ¼w	148056	1		
R8	Res, comp, 330Ω ±5%, ¼w	147967	1		

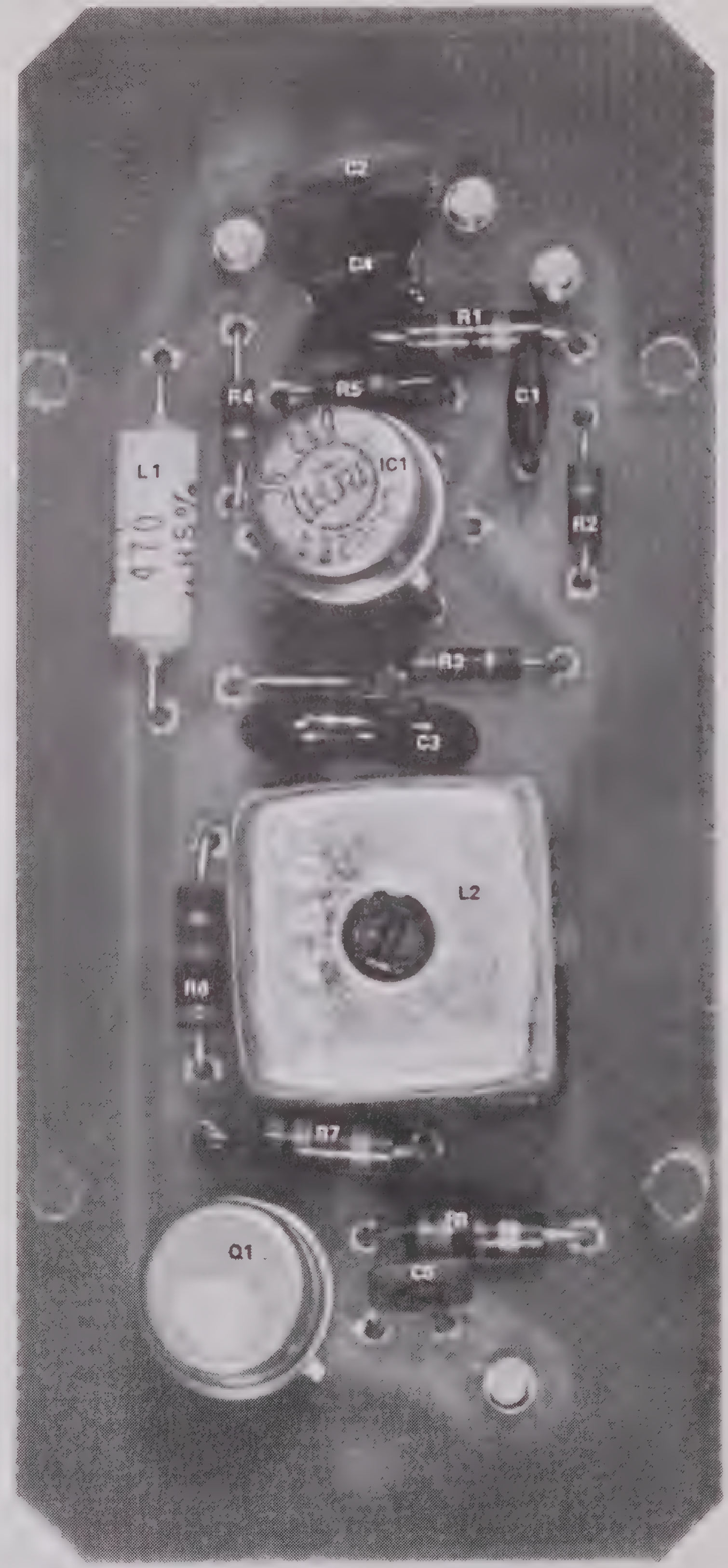

C2
C4
R1
R4
R5
C1
L1
IC1
R2
R3
C3
L2
R6
R7
R8
Q1
C5

Figure 6-2. 1–5 MHz MULTIPLIER PCB ASSEMBLY (644-4144)

SCHEMATIC DIAGRAM INDEX

TITLE	DRAWING NO.
System Block Diagram	645A-1500 (3 sheets)
Wiring Diagram	645A-1002 (5 sheets)
Search VCO	644A-1024
5 MHz Filter Amplifier Module	645A-1101
Input Tray, Bus Block	645A-1198
Spectrum Generator Module	645A-1102
30 MHz Harmonic Selector Module	645A-1103
40 MHz Harmonic Selector Module	645A-1104
50 MHz Harmonic Selector Module	645A-1105
60 MHz Harmonic Selector Module	645A-1106
70 MHz Harmonic Selector Module	645A-1107
30 MHz 10/1 Divider Module	645A-1108
40 MHz 10/1 Divider Module	645A-1109
31 MHz Mixer Module	645A-1121
32 MHz Mixer Module	645A-1122
33 MHz Mixer Module	645A-1123
34 MHz Mixer Module	645A-1124
36 MHz Mixer Module	645A-1125
37 MHz Mixer Module	645A-1126
38 MHz Mixer Module	645A-1127
39 MHz Mixer Module	645A-1128
30/35 MHz Filter Module	645A-1129-1 (2 sheets)
31/36 MHz Filter Module	645A-1129-2 (2 sheets)
32/37 MHz Filter Module	645A-1129-3 (2 sheets)
33/38 MHz Filter Module	645A-1129-4 (2 sheets)
34/39 MHz Filter Module	645A-1129-5 (2 sheets)
Digit Adder Filter/Search Oscillator Module	645A-1129-6
30/39 MHz Gate Module	645A-1133 (3 sheets)
Gate Matrix Module	645A-1134 (2 sheets)
Digit Shift Mixer Module	645A-1135
10/1 Divider No. L Module	645A-1136
Digit Shift Mixer No. 1 Module	645A-1137
Digit Shift Mixer No. 1 Module	645A-1138
Digit Adder Mixer No. 1 Module	645A-1139
Digit Adder Mixer No. 2 Module	645A-1141
Digit Adder Mixer Filter No. 2 Module	645A-1142
Digit Adder Mixer Filter No. 3 Module	645A-1143
Search Mixer Module	645A-1146
10/1 Divider No. 2 Module	645A-1149
Power Supply	645A-1163
Oscillator Module	645A-1185
390, 380 MHz 3 Stage Amp. Modules	645A-1186, 645A-1195
Input Mixer Module	645A-1187
340, 415 MHz 3 Stage Amp. Modules	645A-1188, 645A-1196
First Up Converter Module	645A-1189
Second Up Converter Module	645A-1190
Output Mixer Module	645A-1191
AGC Amplifier Module	645A-1192
Output Amplifier Module	645A-1193
Amplitude Control Module	645A-1194

STRIP NO	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A
BCD INPUT CONNECTOR J1											
BCD DIGIT	DECADE (Hz)										
	10M	1M	100K	10K	1K	100	10	1	.1	.01	SEARCH
1 YEL (A)	41	36	32	27	23	17	13	9	5	1	45
2 GRN (B)	42	37	33	28	24	18	14	10	6	2	46
4 BLU (C)	43	38	34	29	25	19	15	11	7	3	47
8 VIO (D)	44	39	35	30	26	20	16	12	8	4	48
MISCELLENEOUS CONNECTIONS											
	50	51	52	53	54	55	56		58		

SEE TABLE I

MISCELLENEOUS CONNECTIONS

50 −12 VDC OUTPUT
51 GROUND
52 +12 VDC OUTPUT
53 SEARCH DECADE MODE (+12V REMOTE, 0V LOCAL)
54 EXTERNAL AM GATE } FOR OUTPUT CONTROL FUNCTION SEE TABLE II
55 EXTERNAL ALC GATE }
56 · DIGIT MODE (+12V REMOTE, 0V LOCAL)
58 · GROUND

STRIP NO		1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	
DECIMAL OUTPUT CONNECTOR J2												
DECIMAL DIGIT		DECADE (Hz)										
		10M	1M	100K	10K	1K	100	10	1	.1	.01	
0	BLK	93	85	75	59	51	41	33	23	11	1	
1	BRN	94	86	76	60	52	42	34	24	12	2	
2	RED	95	87	77	61	53	43	35	25	13	3	
3	ORN	96	88	78	62	54	44	36	26	14	4	
4	YEL	97	89	79	63	55	45	37	27	15	5	
5	GRN	—	90	80	64	56	46	38	28	16	6	
6	BLU	—	91	81	65	57	47	39	29	17	7	
7	VIO	—	92	82	66	58	48	40	30	18	8	
8	GRY	—	71	83	67	73	49	21	31	19	9	
9	WHT	—	72	84	68	74	50	22	32	20	10	
SEARCH		—	—	119	118	117	116	115	114	113	112	
MISCELLENEOUS CONNECTIONS												
		98	99	100	121	123	124	125				

STRIP 11B

MISCELLENEOUS CONNECTIONS

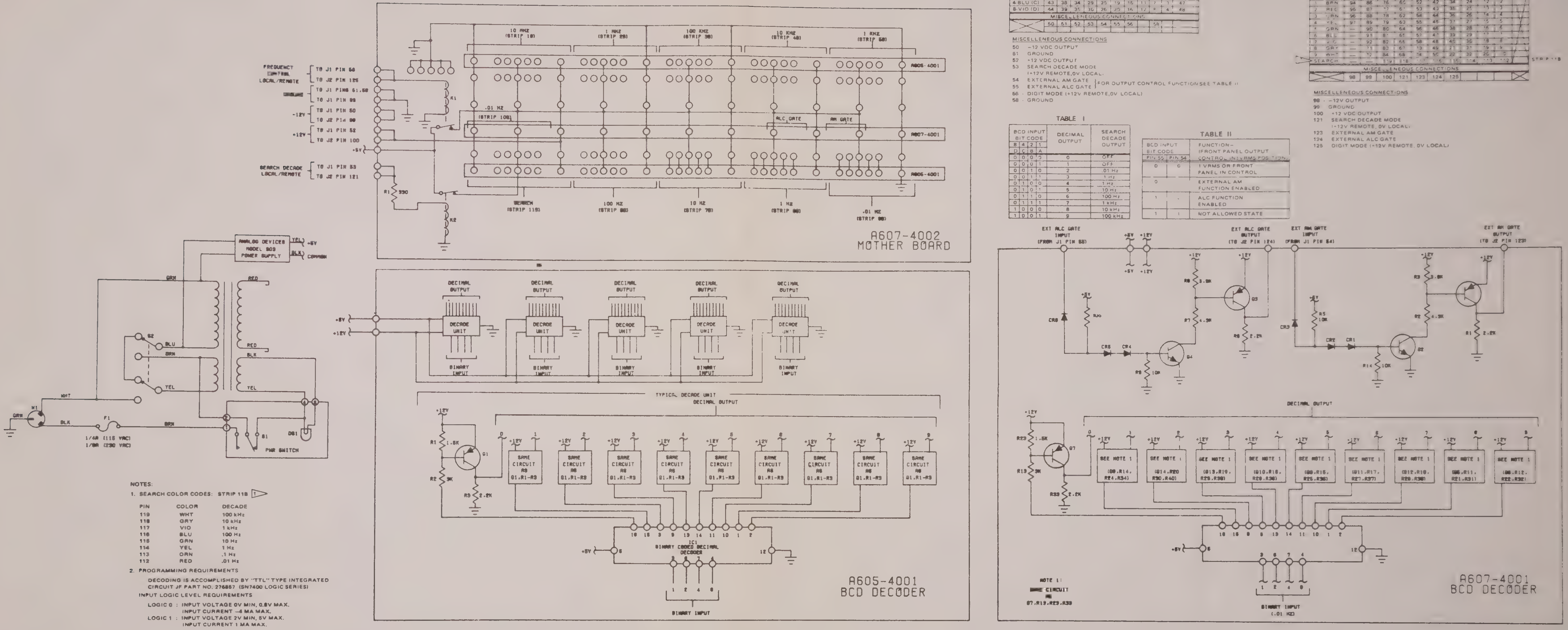
98 · −12V OUTPUT
99 GROUND
100 +12 VDC OUTPUT
121 SEARCH DECADE MODE (+12V REMOTE, 0V LOCAL)
123 EXTERNAL AM GATE
124 EXTERNAL ALC GATE
125 DIGIT MODE (+12V REMOTE, 0V LOCAL)

TABLE I

BCD INPUT BIT CODE				DECIMAL OUTPUT	SEARCH DECADE OUTPUT
8	4	2	1		
D	C	B	A		
0	0	0	0	0	OFF
0	0	0	1	1	OFF
0	0	1	0	2	.01 Hz
0	0	1	1	3	.1 Hz
0	1	0	0	4	1 Hz
0	1	0	1	5	10 Hz
0	1	1	0	6	100 Hz
0	1	1	1	7	1 kHz
1	0	0	0	8	10 kHz
1	0	0	1	9	100 kHz

TABLE II

BCD INPUT BIT CODE		FUNCTION – (FRONT PANEL OUTPUT CONTROL IN 1 VRMS POSITION)
PIN 55	PIN 54	
0	0	1 VRMS OR FRONT PANEL IN CONTROL
0		EXTERNAL AM FUNCTION ENABLED
1	.	ALC FUNCTION ENABLED
1	1	NOT ALLOWED STATE


10 MHZ (STRIP 1B)
1 MHZ (STRIP 2B)
100 KHZ (STRIP 3B)
10 KHZ (STRIP 4B)
1 KHZ (STRIP 5B)
FREQUENCY CONTROL LOCAL/REMOTE
TO J1 PIN 56
TO J2 PIN 125
GROUND
TO J1 PINS 51,58
TO J1 PIN 99
-12V
TO J1 PIN 50
TO J2 PIN 98
+12V
TO J1 PIN 52
TO J2 PIN 100
+5V
SEARCH DECADE LOCAL/REMOTE
TO J1 PIN 53
TO J2 PIN 121
K1
K2
R1 330
.01 HZ (STRIP 10B)
ALC GATE
AM GATE
A605-4001
A607-4001
A605-4001
SEARCH (STRIP 11B)
100 HZ (STRIP 8B)
10 HZ (STRIP 7B)
1 HZ (STRIP 6B)
.01 HZ (STRIP 9B)
A607-4002 MOTHER BOARD
ANALOG DEVICES MODEL 903 POWER SUPPLY
YEL +5V
BLK COMMON
GRN
RED
BLU
BRN
YEL
BLK
WHT
S2
F1
1/4A (115 VAC)
1/8A (230 VAC)
S1
DS1
PWR SWITCH
DECIMAL OUTPUT
DECADE UNIT
BINARY INPUT
TYPICAL DECADE UNIT
DECIMAL OUTPUT
+12V
R1 1.5K
R2 5K
R3 2.2K
Q1
SAME CIRCUIT AS Q1,R1-R3
IC1 BINARY CODED DECIMAL DECODER
BINARY INPUT
A605-4001 BCD DECODER
EXT ALC GATE INPUT (FROM J1 PIN 55)
EXT ALC GATE OUTPUT (TO J2 PIN 124)
EXT AM GATE INPUT (FROM J1 PIN 54)
EXT AM GATE OUTPUT (TO J2 PIN 123)
CR3
CR4
CR5
CR6
CR1
CR2
Q1
Q2
Q3
Q4
R5 10K
R6 2.2K
R7 4.3K
R8 3.3K
R9 10K
R14 10K
SEE NOTE 1
NOTE 1: SAME CIRCUIT AS Q7,R13,R23,R33
BINARY INPUT (.01 HZ)
A607-4001 BCD DECODER

NOTES:

1. SEARCH COLOR CODES: STRIP 11B ▷

PIN	COLOR	DECADE
119	WHT	100 kHz
118	GRY	10 kHz
117	VIO	1 kHz
116	BLU	100 Hz
115	GRN	10 Hz
114	YEL	1 Hz
113	ORN	.1 Hz
112	RED	.01 Hz

2. PROGRAMMING REQUIREMENTS

DECODING IS ACCOMPLISHED BY "TTL" TYPE INTEGRATED CIRCUIT JF PART NO. 276857 (SN7400 LOGIC SERIES)

INPUT LOGIC LEVEL REQUIREMENTS

LOGIC 0 : INPUT VOLTAGE 0V MIN, 0.8V MAX.
INPUT CURRENT −4 MA MAX.
LOGIC 1 : INPUT VOLTAGE 2V MIN, 5V MAX.
INPUT CURRENT 1 MA MAX.

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL A607
BCD TO DECIMAL CONVERTER

Drawing No. A607-1003

REV
a

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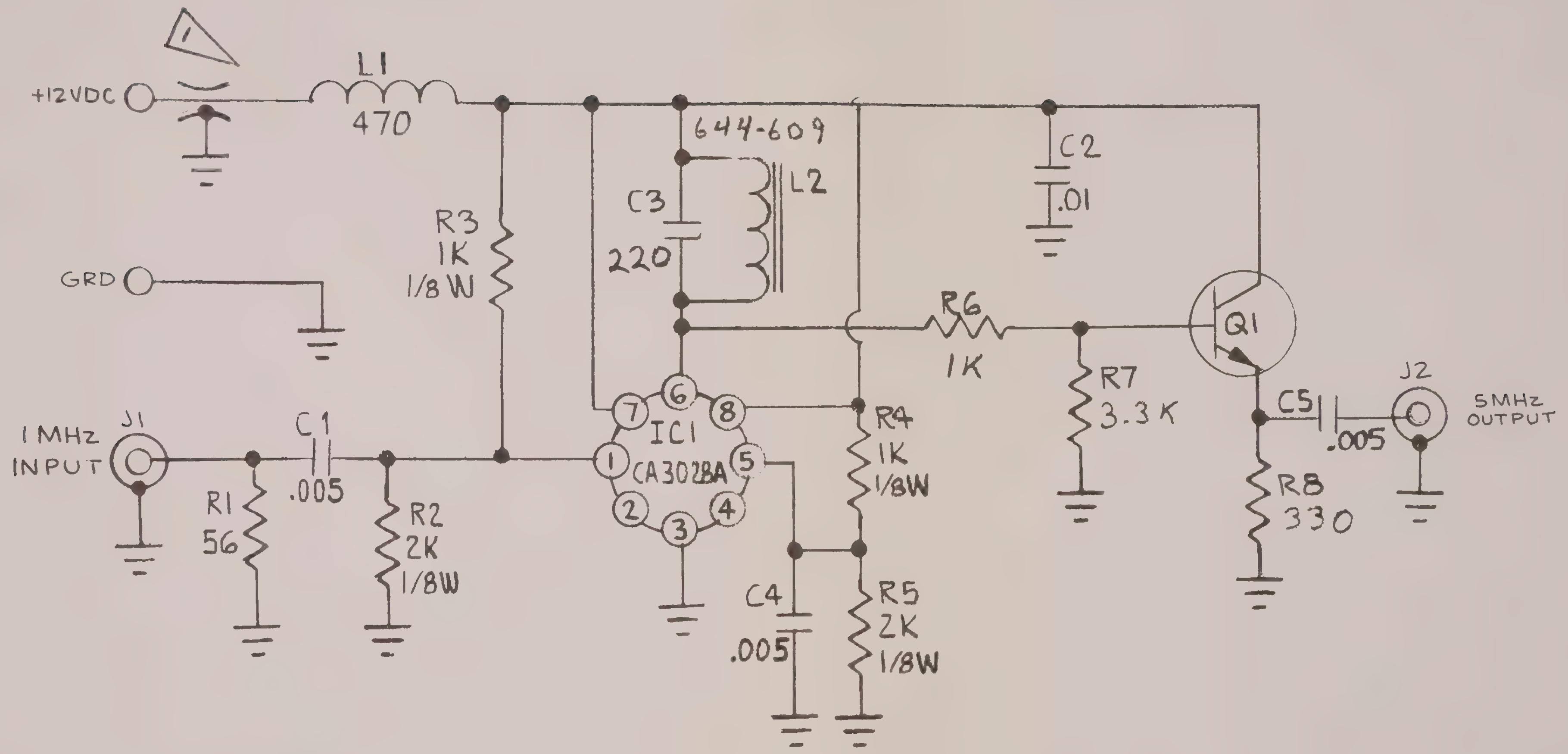
6



1
+12VDC
L1
470
644-609
L2
C3
220
R3
1K
1/8 W
C2
.01
GRD
R6
1K
Q1
R7
3.3 K
J2
5MHz
OUTPUT
C5
.005
R8
330
1 MHz
INPUT
J1
C1
.005
R1
56
R2
2K
1/8W
IC1
CA3028A
1
2
3
4
5
6
7
8
R4
1K
1/8W
C4
.005
R5
2K
1/8W

NOTES:

1. Capacitor values in decimal numbers are in microfarads.
2. Capacitor values in whole numbers are in picofarads.
3. All resistor values are in ohms.
4. All inductor values are in microhenries.
5. ⊳ 2500 pf feed-thru capacitor mounted on metal enclosure.
6. * Factory selected component value.

FUNCTIONAL SCHEMATIC DIAGRAM

1-5 MHz MULTIPLIER

DRAWING NO. 644-1044

REV. b

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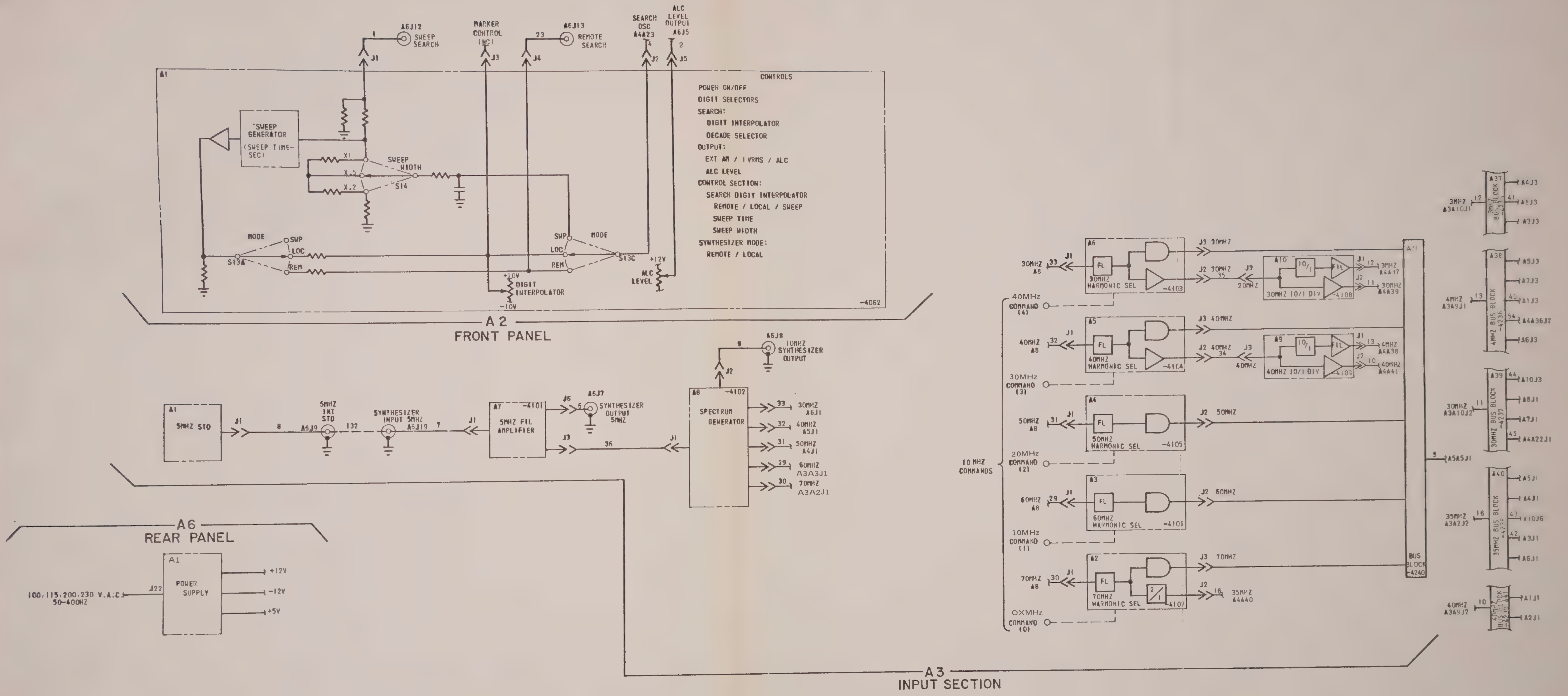
A6J12
SWEEP SEARCH
MARKER CONTROL (NC)
A6J13
REMOTE SEARCH
SEARCH OSC A4A23
ALC LEVEL OUTPUT A6J5
J1
J3
J4
J2
J5
A1
SWEEP GENERATOR (SWEEP TIME-SEC)
SWEEP WIDTH
X1
X.5
X.2
S14
MODE
SWP
LOC
REM
S13A
S13C
+10V
-10V
DIGIT INTERPOLATOR
+12V
ALC LEVEL
CONTROLS
POWER ON/OFF
DIGIT SELECTORS
SEARCH:
DIGIT INTERPOLATOR
DECADE SELECTOR
OUTPUT:
EXT AM / 1VRMS / ALC
ALC LEVEL
CONTROL SECTION:
SEARCH DIGIT INTERPOLATOR
REMOTE / LOCAL / SWEEP
SWEEP TIME
SWEEP WIDTH
SYNTHESIZER MODE:
REMOTE / LOCAL
-4062
A2
FRONT PANEL
A1
5MHZ STD
5MHZ INT STD
A6J9
SYNTHESIZER INPUT 5MHZ
A6J19
A7 -4101
5MHZ FIL AMPLIFIER
J6
A6J7
SYNTHESIZER OUTPUT 5MHZ
A6J8
10MHZ SYNTHESIZER OUTPUT
A8 -4102
SPECTRUM GENERATOR
30MHZ A6J1
40MHZ A5J1
50MHZ A4J1
60MHZ A3A3J1
70MHZ A3A2J1
A6
REAR PANEL
A1
POWER SUPPLY
J22
100,115,200,230 V.A.C. 50-400HZ
+12V
-12V
+5V
10 MHZ COMMANDS
40MHz COMMAND (4)
30MHz COMMAND (3)
20MHz COMMAND (2)
10MHz COMMAND (1)
OXMHz COMMAND (0)
30MHZ A8
40MHZ A8
50MHZ A8
60MHZ A8
70MHZ A8
A6 30MHZ HARMONIC SEL -4103
A5 40MHZ HARMONIC SEL -4104
A4 50MHZ HARMONIC SEL -4105
A3 60MHZ HARMONIC SEL -4105
A2 70MHZ HARMONIC SEL -4107
FL
A10 30MHZ 10/1 DIV -4108
A9 40MHZ 10/1 DIV -4109
3MHZ A4A37
30MHZ A4A39
4MHZ A4A38
40MHZ A4A41
35MHZ A4A40
A11
BUS BLOCK -4240
A5A5J1
A37 3MHZ BUS BLOCK -4235
A38 4MHZ BUS BLOCK -4236
A39 30MHZ BUS BLOCK -4237
A40 35MHZ BUS BLOCK
A41 40MHZ BUS BLOCK
3MHZ A3A10J1
4MHZ A3A9J1
30MHZ A3A10J2
35MHZ A3A2J2
40MHZ A3A9J2
A4J3
A5J3
A3J3
A7J3
A1J3
A4A36J2
A6J3
A10J3
A8J1
A7J1
A4A22J1
A5J1
A4J1
A10J6
A3J1
A6J1
A1J1
A2J1
A3
INPUT SECTION

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
SYSTEM BLOCK DIAGRAM

Drawing No. 645-1500 Sheet 1

REV.
a

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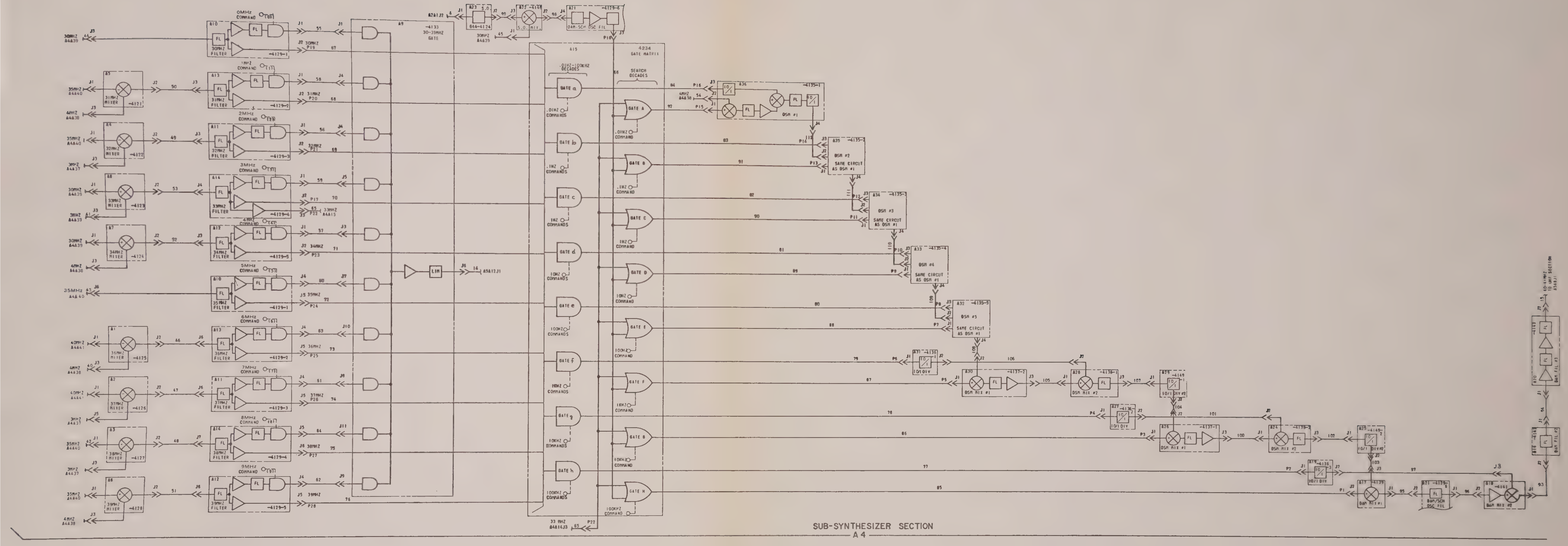
0MHz COMMAND
1MHz COMMAND
2MHz COMMAND
3MHz COMMAND
4MHz COMMAND
5MHz COMMAND
6MHz COMMAND
7MHz COMMAND
8MHz COMMAND
9MHz COMMAND
30MHz FILTER
31MHz FILTER
32MHz FILTER
33MHz FILTER
34MHz FILTER
35MHz FILTER
36MHz FILTER
37MHz FILTER
38MHz FILTER
39MHz FILTER
31MHz MIXER
32MHz MIXER
33MHz MIXER
34MHz MIXER
35MHz MIXER
37MHz MIXER
38MHz MIXER
39MHz MIXER
FL
LIM
30-39MHz GATE
S.O. MIX
BAM/SCH OSC FIL
GATE MATRIX
SEARCH DECADES
.01HZ-100KHZ DECADES
GATE a
GATE b
GATE c
GATE d
GATE e
GATE f
GATE g
GATE h
GATE A
GATE B
GATE C
GATE D
GATE E
GATE F
GATE G
GATE H
.01HZ COMMAND
.1HZ COMMAND
1HZ COMMAND
10HZ COMMAND
100HZ COMMAND
1KHZ COMMAND
10KHZ COMMAND
100KHZ COMMAND
DSM #1
DSM #2
DSM #3
DSM #4
DSM #5
SAME CIRCUIT AS DSM #1
10/1 DIV
DSM MIX #1
DSM MIX #2
BAM MIX #1
BAM MIX #2
BAM/SCH OSC FIL
SUB-SYNTHESIZER SECTION
A4

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
SYSTEM BLOCK DIAGRAM

Drawing No. 645-1500 Sheet 2

REV
b

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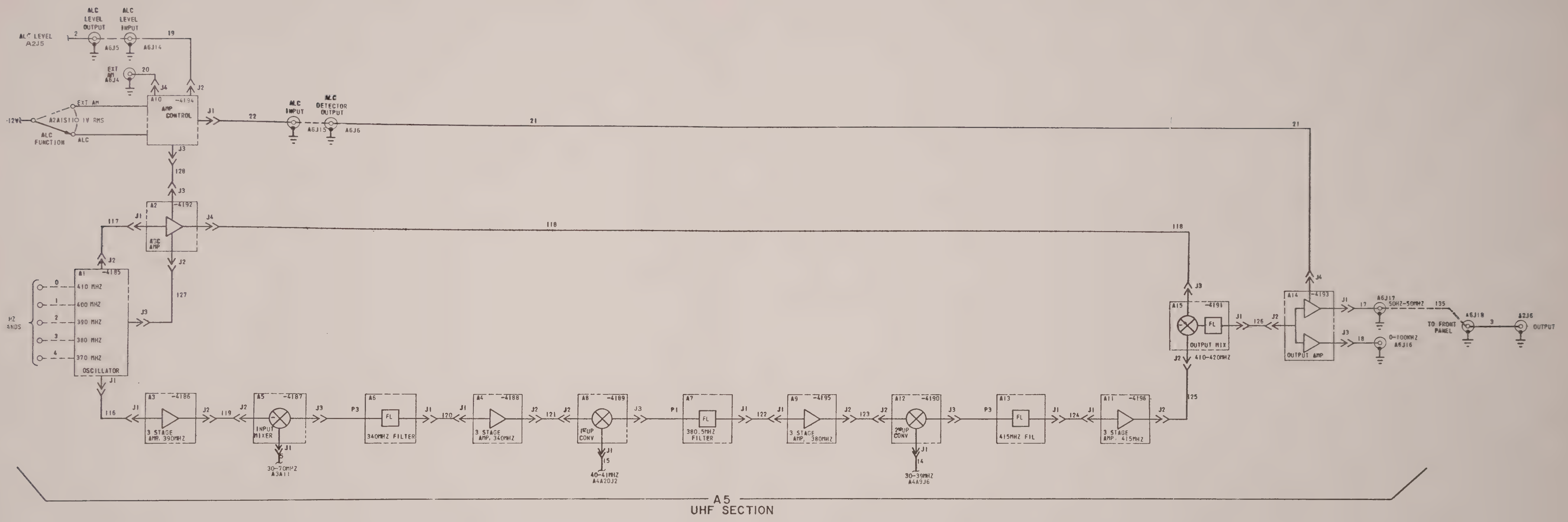
ALC LEVEL A2J5
2
ALC LEVEL OUTPUT
A6J5
ALC LEVEL INPUT
A6J14
19
EXT AM A6J4
20
J4
J2
A10 -4194
AMP CONTROL
-12V
EXT AM
A2A1S1 IO 1V RMS
ALC FUNCTION
ALC
J1
22
ALC INPUT
A6J15
ALC DETECTOR OUTPUT
A6J6
21
J3
128
J3
A2 -4192
AGC AMP
J1
117
J4
118
J2
127
A1 -4185
HZ ANDS
0
410 MHZ
1
400 MHZ
2
390 MHZ
3
380 MHZ
4
370 MHZ
OSCILLATOR
J3
J1
116
A3 -4186
3 STAGE AMP, 390MHZ
J2
119
A5 -4187
INPUT MIXER
J1
30-70MHZ A3A11
J3
P3
A6
340MHZ FILTER
FL
J1
120
A4 -4188
3 STAGE AMP, 340MHZ
121
A8 -4189
1st UP CONV
15
40-41MHZ A4A20J2
P1
A7
380.5MHZ FILTER
122
A9 -4195
3 STAGE AMP, 380MHZ
123
A12 -4190
2nd UP CONV
14
30-39MHZ A4A9J6
A13
415MHZ FIL
124
A11 -4196
3 STAGE AMP, 415MHZ
125
A15 -4191
OUTPUT MIX
410-420MHZ
126
A14 -4193
OUTPUT AMP
17
A6J17
50HZ-50MHZ
135
18
0-100KHZ A6J16
TO FRONT PANEL
A6J18
3
A2J6
OUTPUT
A5
UHF SECTION

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
SYSTEM BLOCK DIAGRAM

Drawing No. 645-1500 Sheet 3

REV
a

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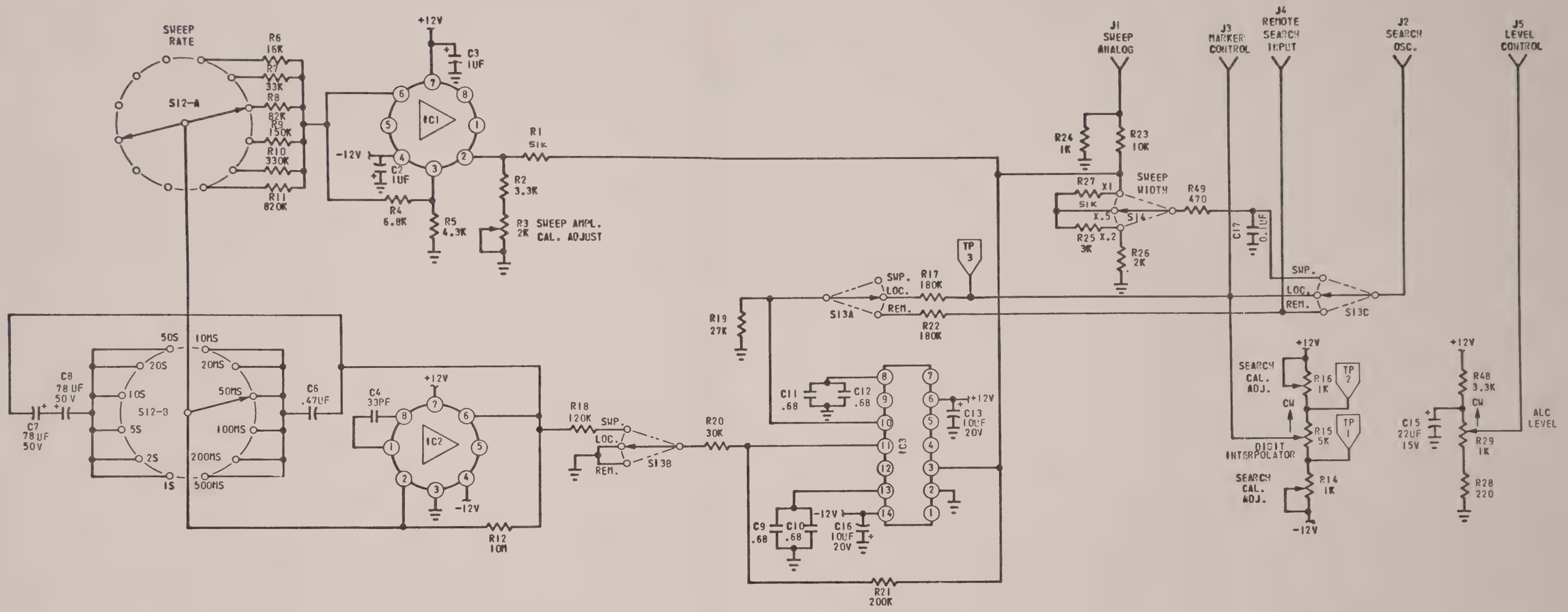
SWEEP RATE
S12-A
R6 16K
R7 33K
R8 82K
R9 150K
R10 330K
R11 820K
+12V
C3 1UF
IC1
-12V
C2 1UF
R4 6.8K
R5 4.3K
R1 51K
R2 3.3K
R3 2K SWEEP AMPL. CAL. ADJUST
J1 SWEEP ANALOG
J3 MARKER CONTROL
J4 REMOTE SEARCH INPUT
J2 SEARCH OSC.
J5 LEVEL CONTROL
R24 1K
R23 10K
R27 51K
X1
SWEEP WIDTH
X.5
X.2
S14
R25 3K
R26 2K
R49 470
C17 0.1UF
TP 3
SWP.
LOC.
REM.
R17 180K
R22 180K
S13A
S13C
R19 27K
50S
10MS
20S
20MS
10S
50MS
S12-B
5S
100MS
2S
200MS
1S
500MS
C8 78 UF 50 V
C7 78 UF 50V
C6 .47UF
C4 33PF
+12V
IC2
-12V
R12 10M
R18 120K
SWP.
LOC.
REM.
S13B
R20 30K
C11 .68
C12 .68
IC3
+12V
C13 10UF 20V
C9 .68
C10 .68
-12V
C16 10UF 20V
R21 200K
+12V
SEARCH CAL. ADJ.
R16 1K
TP 2
CW
R15 5K
TP 1
DIGIT INTERPOLATOR
SEARCH CAL. ADJ.
R14 1K
-12V
+12V
R48 3.3K
CW
C15 22UF 15V
R29 1K
ALC LEVEL
R28 220

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
WIRING DIAGRAM

Dwg. No. 645-1002 (1 of 2) Sheet 1	REV. b

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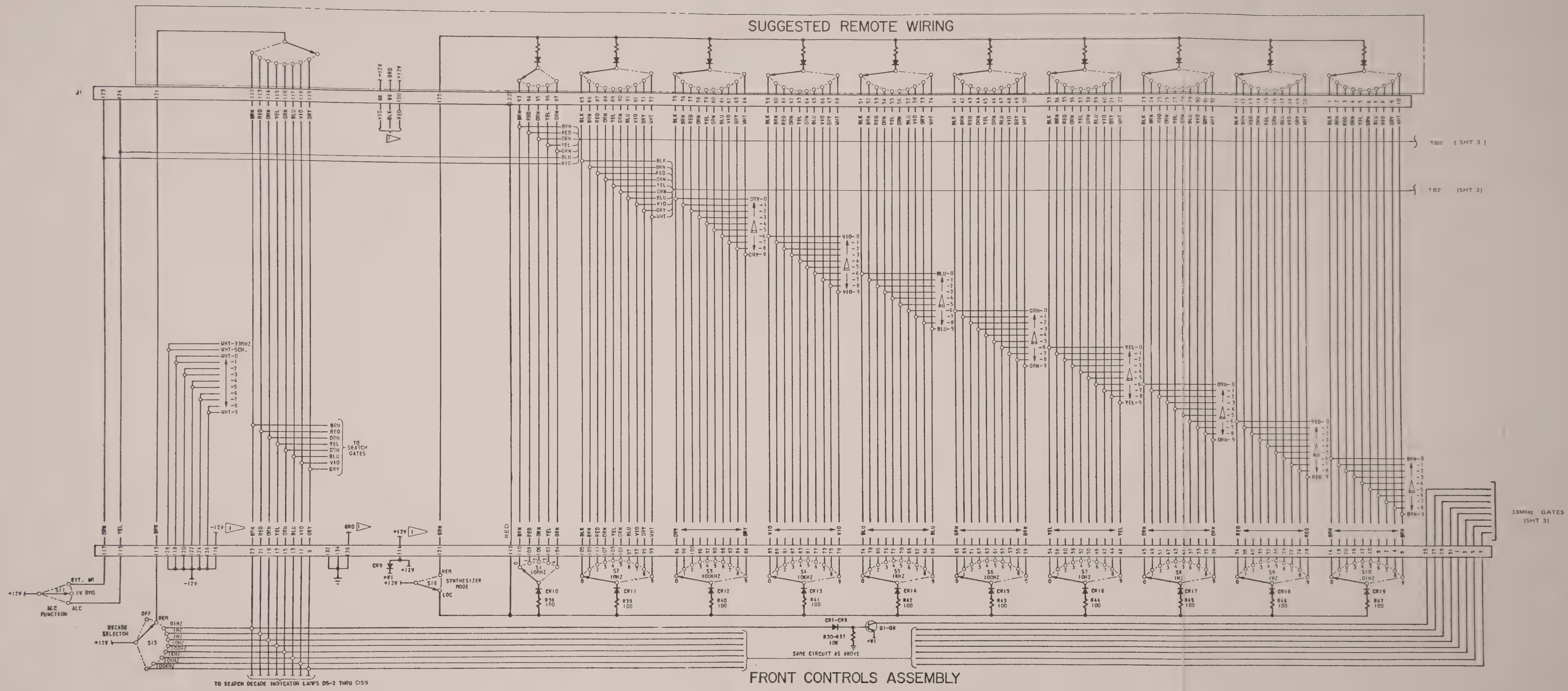
SUGGESTED REMOTE WIRING
J1
TB1 (SHT 3)
TB2 (SHT 3)
TO SEARCH GATES
33MHz GATES (SHT 3)
EXT. AM
1V RMS
ALC
ALC FUNCTION
DECADE SELECTOR
S15
S16
SYNTHESIZER MODE
REM
LOC
OFF
S1 10MHZ
S2 1MHZ
S3 100KHZ
S4 10KHZ
S5 1KHZ
S6 100HZ
S7 10HZ
S8 1HZ
S9 .1HZ
S10 .01HZ
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
CR19
R38 100
R39 100
R40 100
R41 100
R42 100
R43 100
R44 100
R45 100
R46 100
R47 100
CR1-CR8
Q1-Q8
R30-R37 10K
SAME CIRCUIT AS ABOVE
FRONT CONTROLS ASSEMBLY
TO SEARCH DECADE INDICATOR LAMPS DS-2 THRU DS9

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
WIRING DIAGRAM

Dwg. No. 645-1002 (1 of 2) Sheet 2 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
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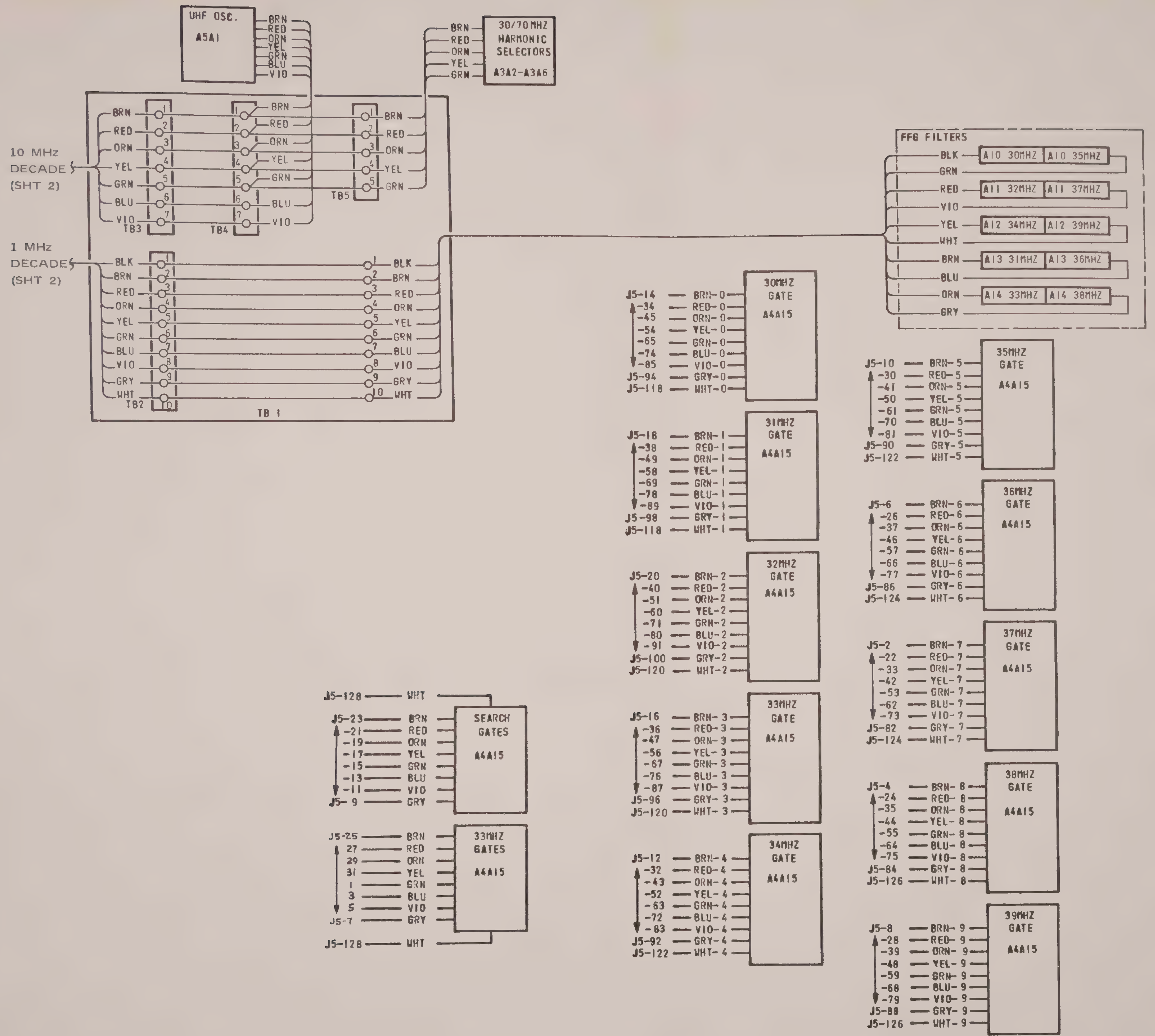
UHF OSC.
A5A1
BRN
RED
ORN
YEL
GRN
BLU
VIO
30/70MHZ HARMONIC SELECTORS
A3A2-A3A6
10 MHz DECADE (SHT 2)
1 MHz DECADE (SHT 2)
TB3
TB4
TB5
TB2
TB 1
BLK
GRY
WHT
FFG FILTERS
A10 30MHZ
A10 35MHZ
A11 32MHZ
A11 37MHZ
A12 34MHZ
A12 39MHZ
A13 31MHZ
A13 36MHZ
A14 33MHZ
A14 38MHZ
30MHZ GATE A4A15
J5-14 BRN-0
-34 RED-0
-45 ORN-0
-54 YEL-0
-65 GRN-0
-74 BLU-0
-85 VIO-0
J5-94 GRY-0
J5-118 WHT-0
31MHZ GATE A4A15
J5-18 BRN-1
-38 RED-1
-49 ORN-1
-58 YEL-1
-69 GRN-1
-78 BLU-1
-89 VIO-1
J5-98 GRY-1
J5-118 WHT-1
32MHZ GATE A4A15
J5-20 BRN-2
-40 RED-2
-51 ORN-2
-60 YEL-2
-71 GRN-2
-80 BLU-2
-91 VIO-2
J5-100 GRY-2
J5-120 WHT-2
33MHZ GATE A4A15
J5-16 BRN-3
-36 RED-3
-47 ORN-3
-56 YEL-3
-67 GRN-3
-76 BLU-3
-87 VIO-3
J5-96 GRY-3
J5-120 WHT-3
34MHZ GATE A4A15
J5-12 BRN-4
-32 RED-4
-43 ORN-4
-52 YEL-4
-63 GRN-4
-72 BLU-4
-83 VIO-4
J5-92 GRY-4
J5-122 WHT-4
35MHZ GATE A4A15
J5-10 BRN-5
-30 RED-5
-41 ORN-5
-50 YEL-5
-61 GRN-5
-70 BLU-5
-81 VIO-5
J5-90 GRY-5
J5-122 WHT-5
36MHZ GATE A4A15
J5-6 BRN-6
-26 RED-6
-37 ORN-6
-46 YEL-6
-57 GRN-6
-66 BLU-6
-77 VIO-6
J5-86 GRY-6
J5-124 WHT-6
37MHZ GATE A4A15
J5-2 BRN-7
-22 RED-7
-33 ORN-7
-42 YEL-7
-53 GRN-7
-62 BLU-7
-73 VIO-7
J5-82 GRY-7
J5-124 WHT-7
38MHZ GATE A4A15
J5-4 BRN-8
-24 RED-8
-35 ORN-8
-44 YEL-8
-55 GRN-8
-64 BLU-8
-75 VIO-8
J5-84 GRY-8
J5-126 WHT-8
39MHZ GATE A4A15
J5-8 BRN-9
-28 RED-9
-39 ORN-9
-48 YEL-9
-59 GRN-9
-68 BLU-9
-79 VIO-9
J5-88 GRY-9
J5-126 WHT-9
SEARCH GATES A4A15
J5-128 WHT
J5-23 BRN
-21 RED
-19 ORN
-17 YEL
-15 GRN
-13 BLU
-11 VIO
J5-9 GRY
33MHZ GATES A4A15
J5-25 BRN
27 RED
29 ORN
31 YEL
1 GRN
3 BLU
5 VIO
J5-7 GRY
J5-128 WHT

NOTES:

1 INPUT FROM TB-3.

2 -0 FROM 30MHZ GATE
-1 FROM 31MHZ GATE
-2 FROM 32MHZ GATE
-3 FROM 33MHZ GATE
-4 FROM 34MHZ GATE
-5 FROM 35MHZ GATE
-6 FROM 36MHZ GATE
-7 FROM 37MHZ GATE
-8 FROM 38MHZ GATE
-9 FROM 39MHZ GATE

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
WIRING DIAGRAM

Dwg. No. 645-1002 (1 of 2) Sheet 3
REV.
a

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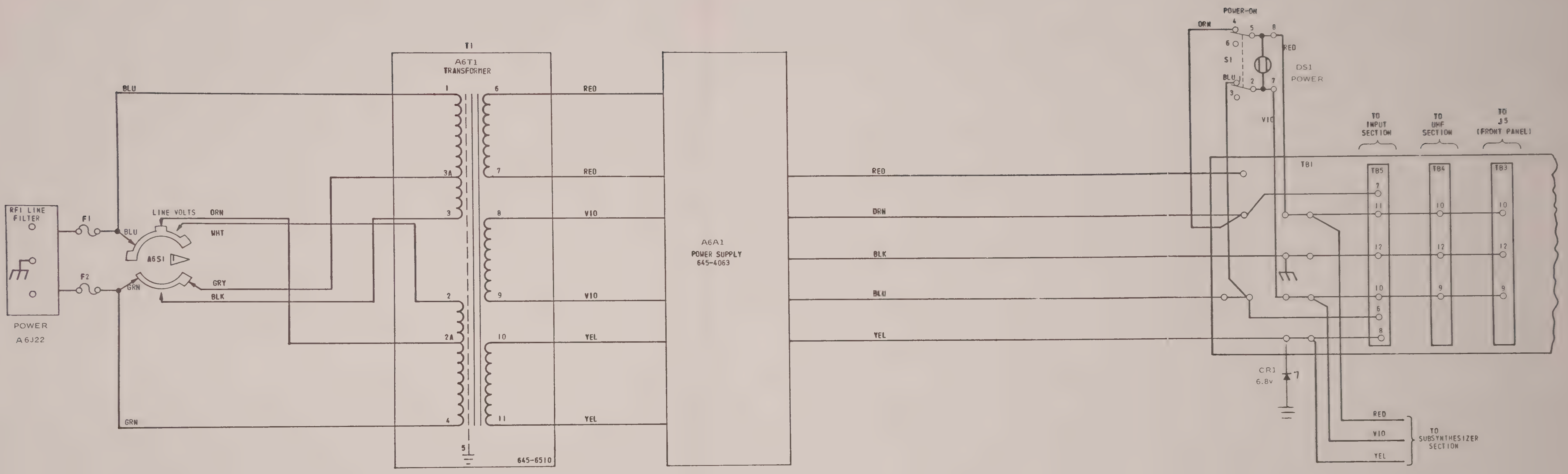
13


RFI LINE FILTER
POWER
A6J22
F1
F2
BLU
GRN
LINE VOLTS
ORN
WHT
A6S1
GRY
BLK
T1
A6T1
TRANSFORMER
1
3A
3
2
2A
4
5
6
7
8
9
10
11
645-6510
RED
RED
VIO
VIO
YEL
YEL
A6A1
POWER SUPPLY
645-4063
RED
ORN
BLK
BLU
YEL
POWER-ON
ORN
4
5
8
6
S1
BLU
2
7
3
RED
DS1
POWER
VIO
TO INPUT SECTION
TO UHF SECTION
TO J5 (FRONT PANEL)
TB1
TB5
TB4
TB3
7
11
12
10
6
8
10
12
9
10
12
9
CR1
6.8v
RED
VIO
YEL
TO SUBSYNTHESIZER SECTION

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
WIRING DIAGRAM

Dwg. No. 645-1002 (2 of 2) Sheet 1

REV.
a

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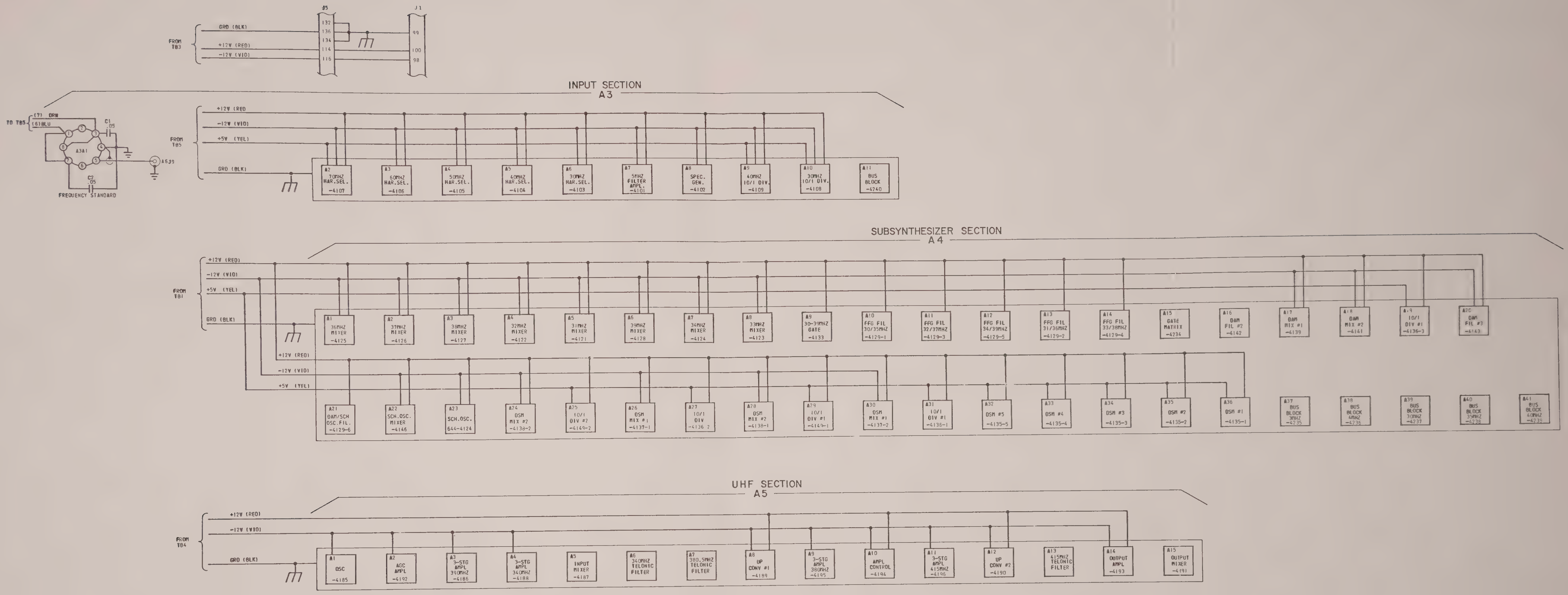
J5
J1
FROM TB3
GRD (BLK)
+12V (RED)
-12V (VIO)
132
136
134
114
116
99
100
98
INPUT SECTION
A3
TO TB5
(7) ORN
(6)BLU
C1 .05
C2 .05
A3A1
A6J9
FREQUENCY STANDARD
FROM TB5
+12V (RED
-12V (VIO)
+5V (YEL)
GRD (BLK)
A2 70MHZ HAR.SEL. -4107
A3 60MHZ HAR.SEL. -4106
A4 50MHZ HAR.SEL. -4105
A5 40MHZ HAR.SEL. -4104
A6 30MHZ HAR.SEL. -4103
A7 5MHZ FILTER AMPL. -4101
A8 SPEC. GEN. -4102
A9 40MHZ 10/1 DIV. -4109
A10 30MHZ 10/1 DIV. -4108
A11 BUS BLOCK -4240
SUBSYNTHESIZER SECTION
A4
FROM TB1
+12V (RED)
-12V (VIO)
+5V (YEL)
GRD (BLK)
A1 36MHZ MIXER -4125
A2 37MHZ MIXER -4126
A3 38MHZ MIXER -4127
A4 32MHZ MIXER -4122
A5 31MHZ MIXER -4121
A6 39MHZ MIXER -4128
A7 34MHZ MIXER -4124
A8 33MHZ MIXER -4123
A9 30-39MHZ GATE -4133
A10 FFG FIL 30/35MHZ -4129-1
A11 FFG FIL 32/37MHZ -4129-3
A12 FFG FIL 34/39MHZ -4129-5
A13 FFG FIL 31/36MHZ -4129-2
A14 FFG FIL 33/38MHZ -4129-4
A15 GATE MATRIX -4234
A16 DAM FIL #2 -4142
A17 DAM MIX #1 -4139
A18 DAM MIX #2 -4141
A19 10/1 DIV #1 -4136-3
A20 DAM FIL #3 -4143
+12V (RED)
-12V (VIO)
+5V (YEL)
A21 DAM/SCH OSC.FIL. -4129-6
A22 SCH.OSC. MIXER -4146
A23 SCH.OSC. 644-4124
A24 DSM MIX #2 -4138-2
A25 10/1 DIV #2 -4149-2
A26 DSM MIX #1 -4137-1
A27 10/1 DIV -4136 2
A28 DSM MIX #2 -4138-1
A29 10/1 DIV #1 -4149-1
A30 DSM MIX #1 -4137-2
A31 10/1 DIV #1 -4136-1
A32 DSM #5 -4135-5
A33 DSM #4 -4135-4
A34 DSM #3 -4135-3
A35 DSM #2 -4135-2
A36 DSM #1 -4135-1
A37 BUS BLOCK 3MHZ -4235
A38 BUS BLOCK 4MHZ -4236
A39 BUS BLOCK 30MHZ -4237
A40 BUS BLOCK 35MHZ -4238
A41 BUS BLOCK 40MHZ -4239
UHF SECTION
A5
FROM TB4
+12V (RED)
-12V (VIO)
GRD (BLK)
A1 OSC -4185
A2 AGC AMPL -4192
A3 3-STG AMPL 390MHZ -4186
A4 3-STG AMPL 340MHZ -4188
A5 INPUT MIXER -4187
A6 340MHZ TELONIC FILTER
A7 380.5MHZ TELONIC FILTER
A8 UP CONV #1 -4189
A9 3-STG AMPL 380MHZ -4195
A10 AMPL CONTROL -4194
A11 3-STG AMPL 415MHZ -4196
A12 UP CONV #2 -4190
A13 415MHZ TELONIC FILTER
A14 OUTPUT AMPL -4193
A15 OUTPUT MIXER -4191

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL 645A
WIRING DIAGRAM

Dwg. No. 645-1002 (2 of 2) Sht. 2	REV a

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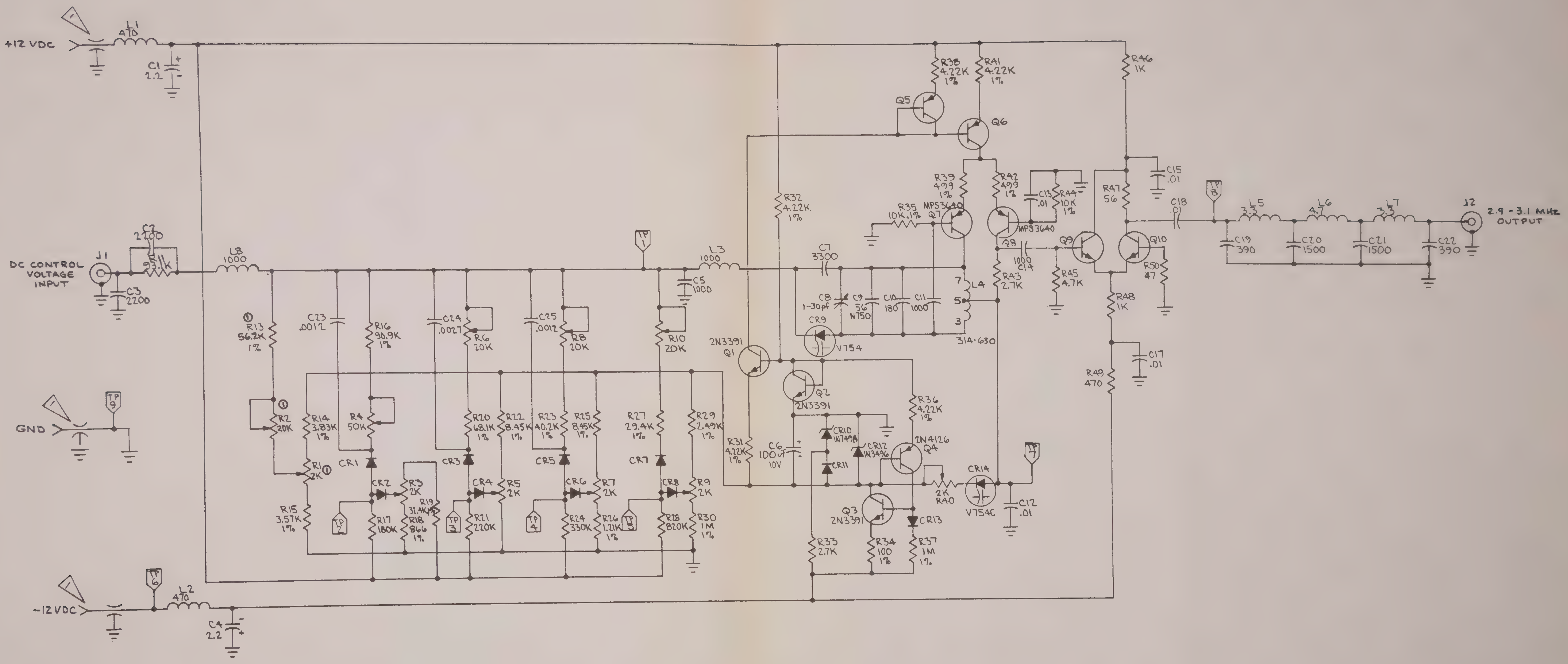
+12 VDC
L1 470
C1 2.2
DC CONTROL VOLTAGE INPUT
J1
C2 2200
C3 2200
L8 1000
TP 1
L3 1000
C5 1000
C7 3300
C8 1-30pf
C9 56 N750
C10 180
C11 1000
CR9 V754
L4 314-630
R13 56.2K 1%
C23 .0012
R16 90.9K 1%
C24 .0027
R6 20K
C25 .0012
R8 20K
R10 20K
R2 20K
R14 3.83K 1%
R4 50K
R20 68.1K 1%
R22 8.45K 1%
R23 40.2K 1%
R25 8.45K 1%
R27 29.4K 1%
R29 2.49K 1%
R1 2K
CR1
CR2
R3 2K
R19 31.4K
R18 866 1%
R17 180K
CR3
CR4
R5 2K
R21 220K
CR5
CR6
R7 2K
R24 330K
R26 1.21K 1%
CR7
CR8
R9 2K
R28 820K
R30 1M 1%
R15 3.57K 1%
TP 2
TP 3
TP 4
TP 5
GND
TP 9
-12 VDC
TP 6
L2 470
C4 2.2
2N3391 Q1
Q2 2N3391
R31 4.22K 1%
C6 100uf 10V
CR10 1N749A
CR11
CR12 1N3496
2N4126 Q4
R36 4.22K 1%
Q3 2N3391
R33 2.7K
R34 100 1%
R37 1M 1%
CR13
R40 2K
CR14 V754C
TP 7
C12 .01
R32 4.22K 1%
R38 4.22K 1%
R41 4.22K 1%
Q5
Q6
R39 499 1%
R42 499 1%
R35 10K 1%
MPS3640 Q7
MPS3640 Q8
C13 .01
R44 10K 1%
C14 1000
R43 2.7K
R45 4.7K
R46 1K
R47 56
C15 .01
Q9
Q10
R50 47
R48 1K
C17 .01
R49 470
C18 .01
TP 8
L5 3.3
L6 4.7
L7 3.3
C19 390
C20 1500
C21 1500
C22 390
J2
2.9 - 3.1 MHz OUTPUT

CHANGES:

① For S/N 123 thru 176:
R1 was 1k
R2 was 10k
R13 was 61.9k

NOTES:

1. Capacitor values in decimal numbers are in microfarads.
2. Capacitor values in whole numbers are in picofarads.
3. All resistor values are in ohms.
4. All inductor values are in microhenries.
5. ▷ 2500 pf feed-thru capacitor mounted on metal enclosure.
6. * Factory selected component value.

FUNCTIONAL SCHEMATIC DIAGRAM

SEARCH VCO

DRAWING NO. 644-1024

REV. d

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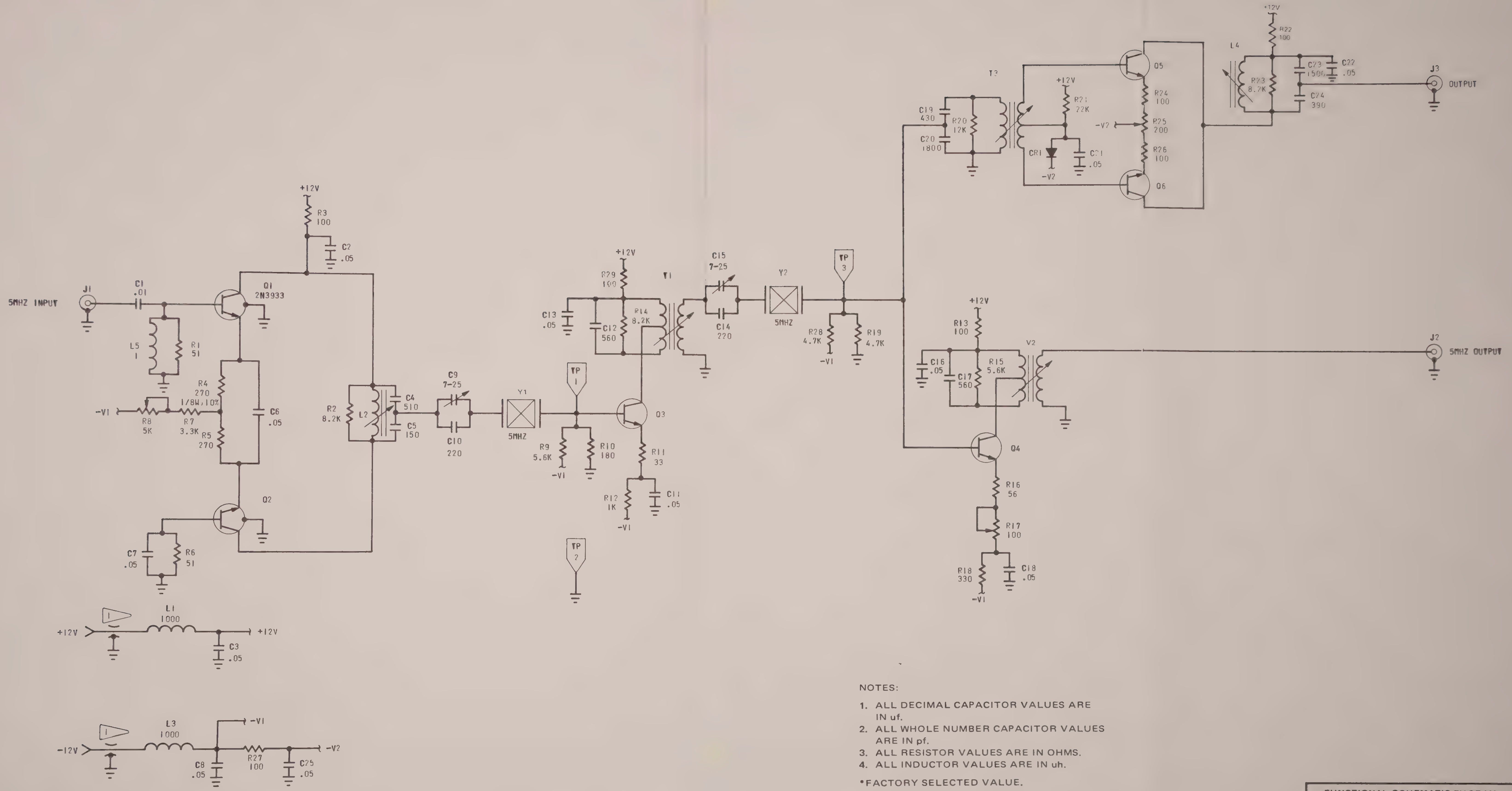
5MHZ INPUT
J1
C1 .01
L5 1
R1 51
Q1 2N3933
+12V
R3 100
C2 .05
R4 270
R5 270
1/8W,10%
R7 3.3K
R8 5K
-V1
C6 .05
Q2
C7 .05
R6 51
R2 8.2K
L2
C4 510
C5 150
C9 7-25
C10 220
Y1 5MHZ
TP 1
TP 2
R9 5.6K
R10 180
Q3
R11 33
R12 1K
C11 .05
R29 100
C13 .05
C12 560
R14 8.2K
T1
C15 7-25
C14 220
Y2 5MHZ
TP 3
R28 4.7K
R19 4.7K
C19 430
C20 1800
R20 12K
T2
R21 22K
CR1
-V2
C21 .05
Q5
Q6
R24 100
R25 200
R26 100
L4
R22 100
R23 8.2K
C23 1500
C22 .05
C24 390
J3 OUTPUT
R13 100
C16 .05
C17 560
R15 5.6K
V2
J2 5MHZ OUTPUT
Q4
R16 56
R17 100
R18 330
C18 .05
L1 1000
C3 .05
L3 1000
-12V
C8 .05
R27 100
C25 .05

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

CHANGES

① FOR S/N 154 AND ON:
C9 AND C15 DELETED
R15 CHANGED FROM
5.6K TO 15K.

FUNCTIONAL SCHEMATIC DIAGRAM

5 MHz FILTER AMPLIFIER
MODULE

Drawing No. 645-1101 REV C

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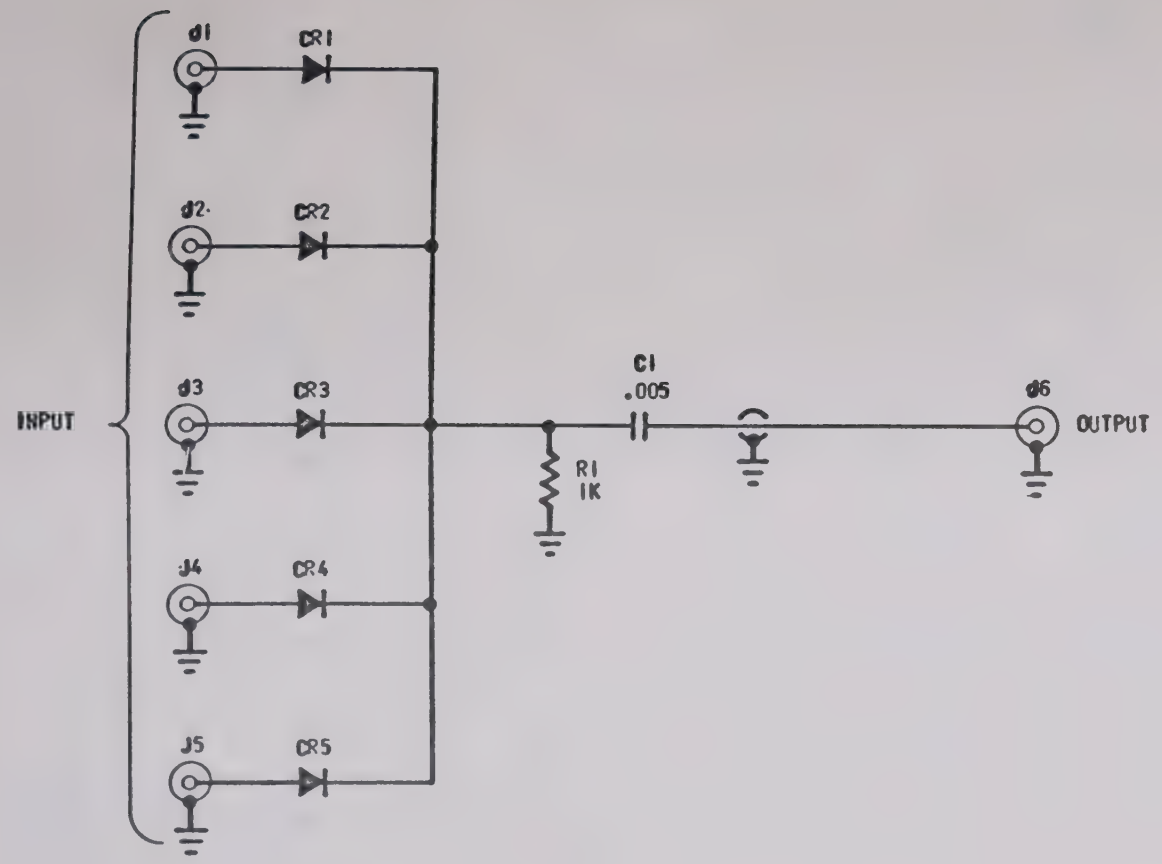
INPUT
J1
J2
J3
J4
J5
CR1
CR2
CR3
CR4
CR5
R1
1K
C1
.005
J6
OUTPUT

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

INPUT TRAY
BUSS BLOCK

Drawing No. 645-1198

REV
a

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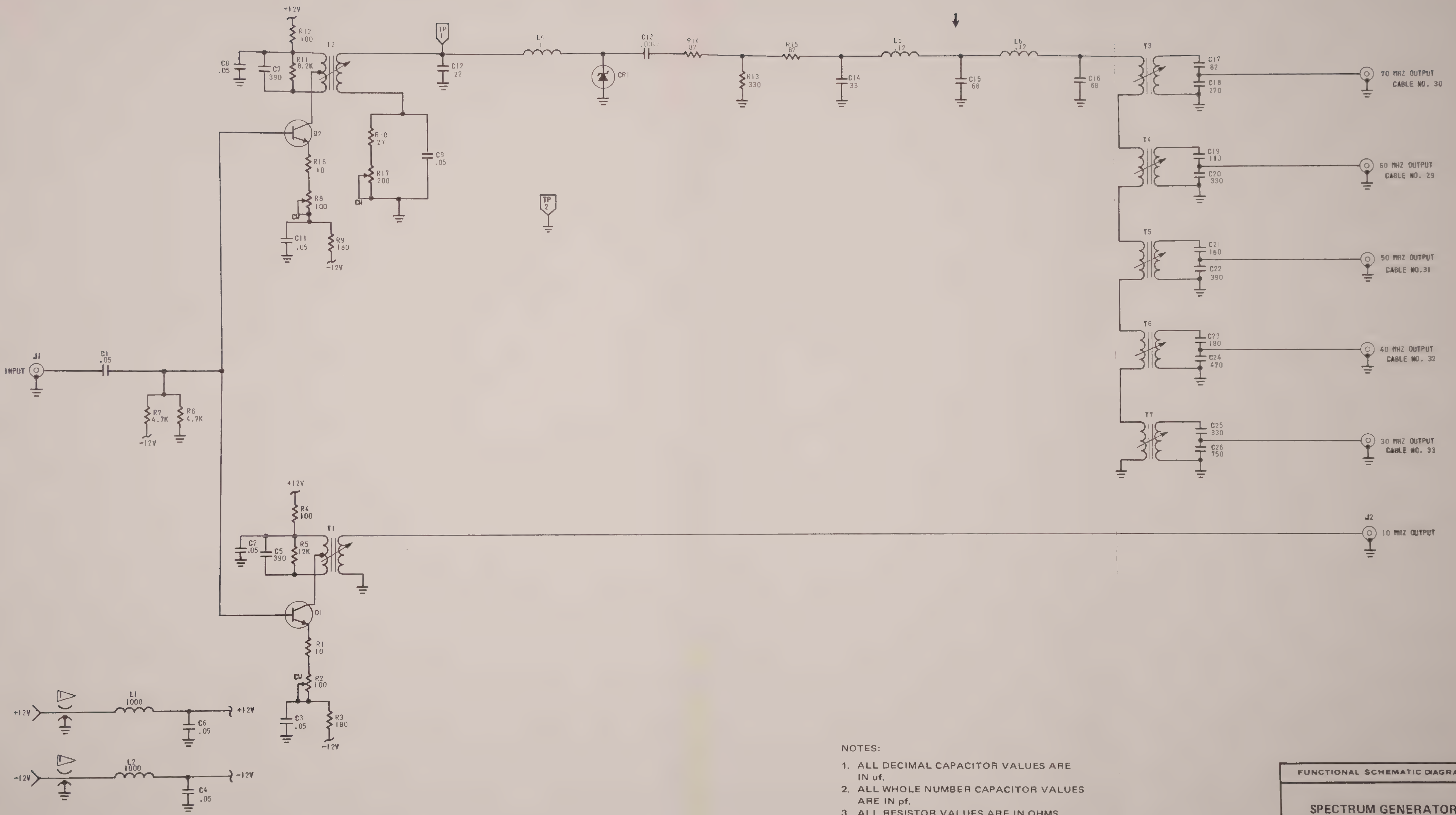
+12V
R12
100
C8
.05
C7
390
R11
8.2K
T2
TP
1
C12
22
L4
1
CR1
C13
.0012
R14
82
R13
330
R15
82
C14
33
L5
.12
C15
68
L6
.12
C16
68
T3
C17
82
C18
270
70 MHZ OUTPUT
CABLE NO. 30
T4
C19
110
C20
330
60 MHZ OUTPUT
CABLE NO. 29
T5
C21
160
C22
390
50 MHZ OUTPUT
CABLE NO.31
T6
C23
180
C24
470
40 MHZ OUTPUT
CABLE NO. 32
T7
C25
330
C26
750
30 MHZ OUTPUT
CABLE NO. 33
Q2
R10
27
C9
.05
R17
200
CW
R16
10
R8
100
CW
C11
.05
R9
180
-12V
TP
2
J1
INPUT
C1
.05
R7
4.7K
R6
4.7K
-12V
+12V
R4
100
C2
.05
C5
390
R5
12K
T1
J2
10 MHZ OUTPUT
Q1
R1
10
CW
R2
100
C3
.05
R3
180
-12V
+12V
1
L1
1000
C6
.05
+12V
-12V
1
L2
1000
C4
.05
-12V

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

SPECTRUM GENERATOR
MODULE

Drawing No. 645-1102

REV.
b

19

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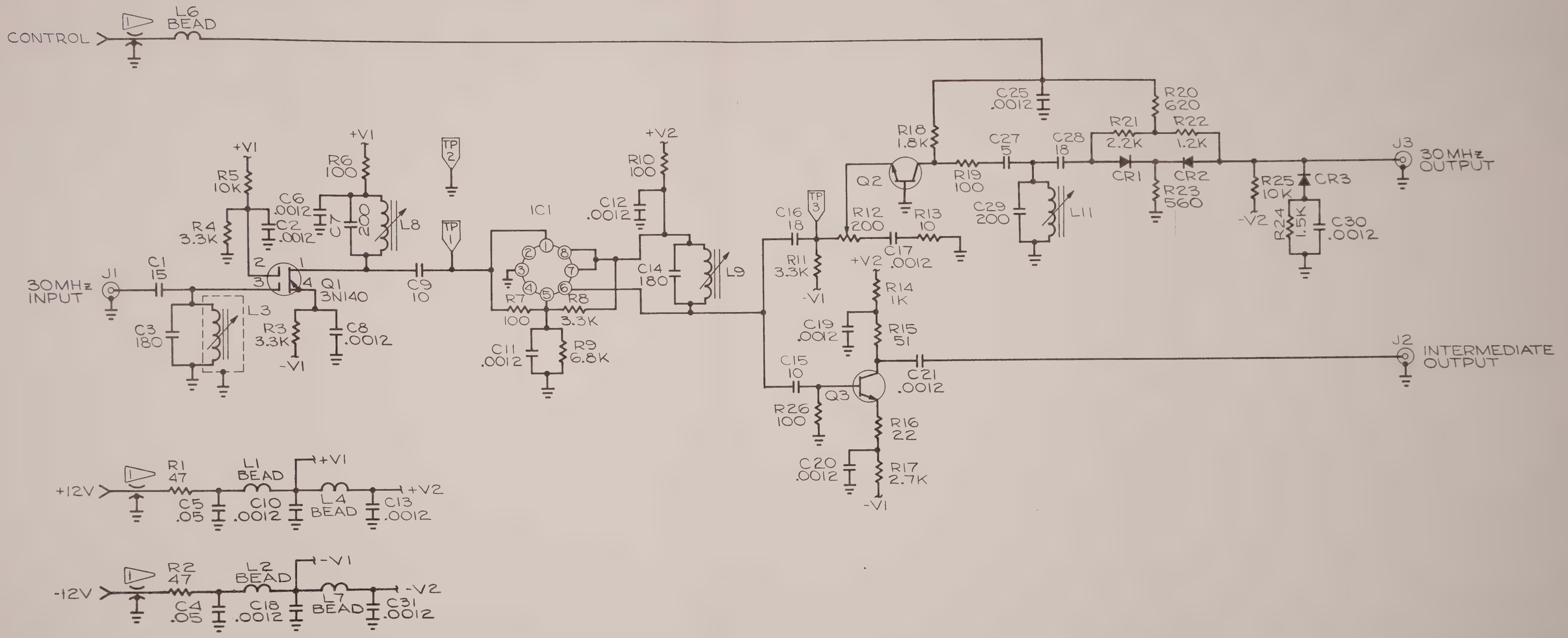

CONTROL
1
L6
BEAD
C25
.0012
R20
620
R21
2.2K
R22
1.2K
R18
1.8K
C27
5
C28
18
CR1
CR2
R23
560
R25
10K
CR3
-V2
R24
1.5K
C30
.0012
J3
30MHz
OUTPUT
Q2
R19
100
C29
200
L11
+V1
R5
10K
R4
3.3K
C6
.0012
C2
.0012
C7
20
R6
100
L8
TP
2
TP
1
IC1
+V2
R10
100
C12
.0012
C14
180
L9
C16
18
TP
3
R12
200
R13
10
C17
.0012
R11
3.3K
-V1
J1
30MHz
INPUT
C1
15
C3
180
L3
3
2
1
4
Q1
3N140
R3
3.3K
-V1
C8
.0012
C9
10
1
2
3
4
5
6
7
8
R7
100
R8
3.3K
C11
.0012
R9
6.8K
R14
1K
C19
.0012
R15
51
C15
10
C21
.0012
J2
INTERMEDIATE
OUTPUT
Q3
R26
100
R16
22
C20
.0012
R17
2.7K
-V1
+12V
R1
47
L1
BEAD
+V1
L4
BEAD
+V2
C5
.05
C10
.0012
C13
.0012
-12V
R2
47
L2
BEAD
-V1
L7
BEAD
-V2
C4
.05
C18
.0012
C31
.0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

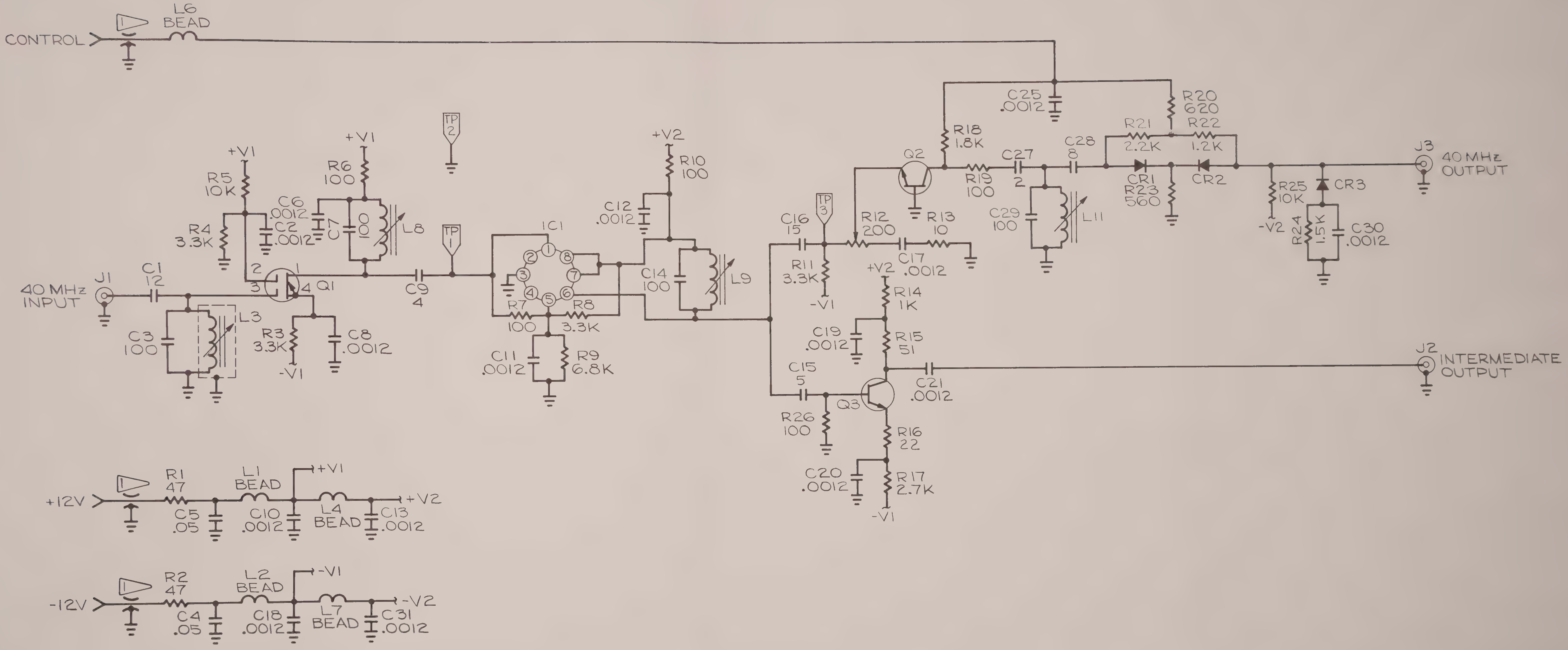
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

30 MHz HARMONIC SELECTOR MODULE

Drawing No. 645-1103 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


CONTROL
L6
BEAD
C25
.0012
R20
620
R21
2.2K
R22
1.2K
R18
1.8K
Q2
C27
2
C28
8
R19
100
CR1
R23
560
CR2
R25
10K
CR3
J3
40 MHz
OUTPUT
-V2
R24
1.5K
C30
.0012
C29
100
L11
TP
2
TP
1
TP
3
+V1
R6
100
C6
.0012
C7
100
L8
+V1
R5
10K
R4
3.3K
C2
.0012
+V2
R10
100
C12
.0012
IC1
C14
100
L9
C16
15
R11
3.3K
-V1
R12
200
R13
10
C17
.0012
40 MHz
INPUT
J1
C1
12
Q1
C9
4
C3
100
L3
R3
3.3K
-V1
C8
.0012
R7
100
R8
3.3K
C11
.0012
R9
6.8K
+V2
R14
1K
C19
.0012
R15
51
C15
5
Q3
C21
.0012
J2
INTERMEDIATE
OUTPUT
R26
100
R16
22
C20
.0012
R17
2.7K
-V1
+12V
R1
47
L1
BEAD
+V1
C5
.05
C10
.0012
L4
BEAD
C13
.0012
+V2
-12V
R2
47
L2
BEAD
-V1
C4
.05
C18
.0012
L7
BEAD
C31
.0012
-V2
1

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

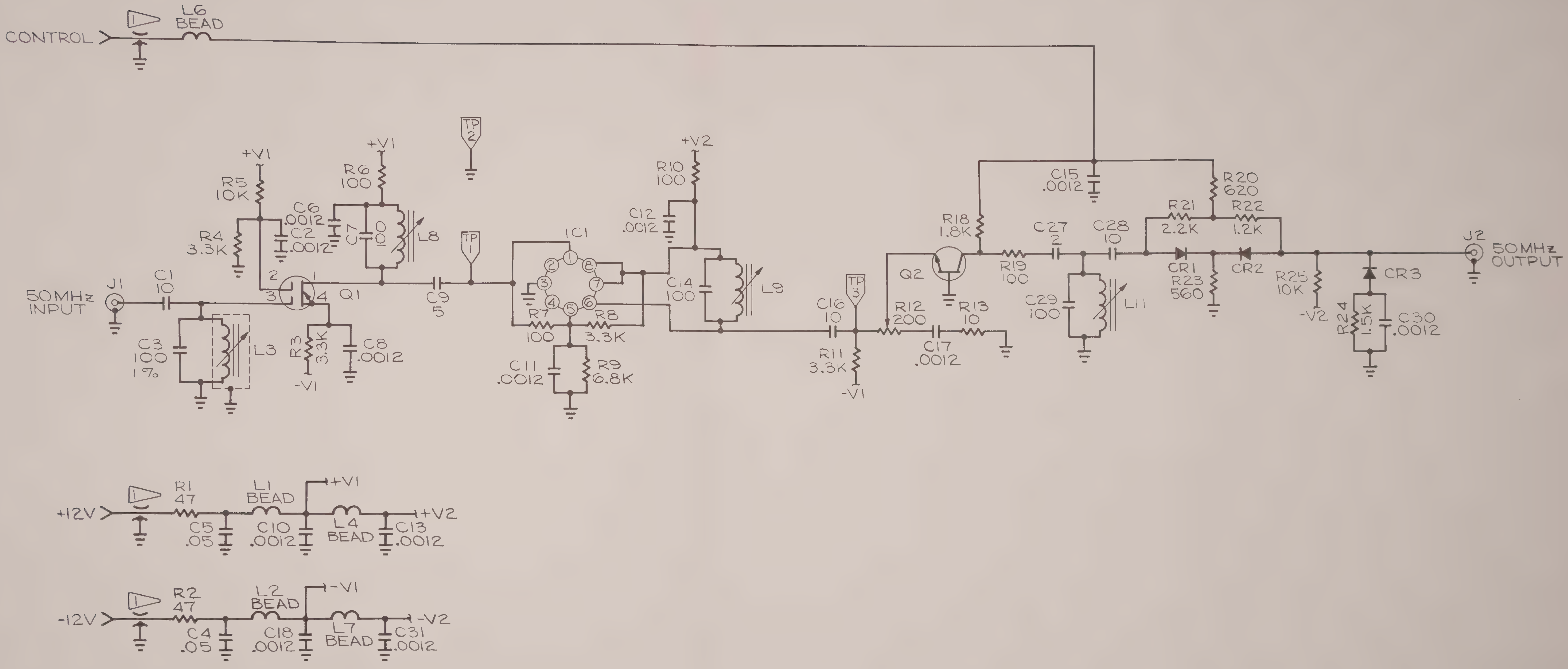
40 MHz HARMONIC SELECTOR
MODULE

Drawing No. 645-1104

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

21


CONTROL
1
L6
BEAD
+V1
R5
10K
R4
3.3K
C6
.0012
C2
.0012
+V1
R6
100
C7
100
L8
TP
2
TP
1
50MHz
INPUT
J1
C1
10
2
3
1
4
Q1
C9
5
C3
100
1%
L3
R3
3.3K
-V1
C8
.0012
IC1
1
2
3
4
5
6
7
8
R7
100
R8
3.3K
C11
.0012
R9
6.8K
+V2
R10
100
C12
.0012
C14
100
L9
TP
3
C16
10
R11
3.3K
-V1
R12
200
R13
10
C17
.0012
Q2
R18
1.8K
C15
.0012
R20
620
R21
2.2K
R22
1.2K
C27
2
C28
10
R19
100
C29
100
L11
CR1
R23
560
CR2
R25
10K
-V2
CR3
R24
1.5K
C30
.0012
J2
50MHz
OUTPUT
+12V
1
R1
47
L1
BEAD
+V1
+V2
C5
.05
C10
.0012
L4
BEAD
C13
.0012
-12V
1
R2
47
L2
BEAD
-V1
-V2
C4
.05
C18
.0012
L7
BEAD
C31
.0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

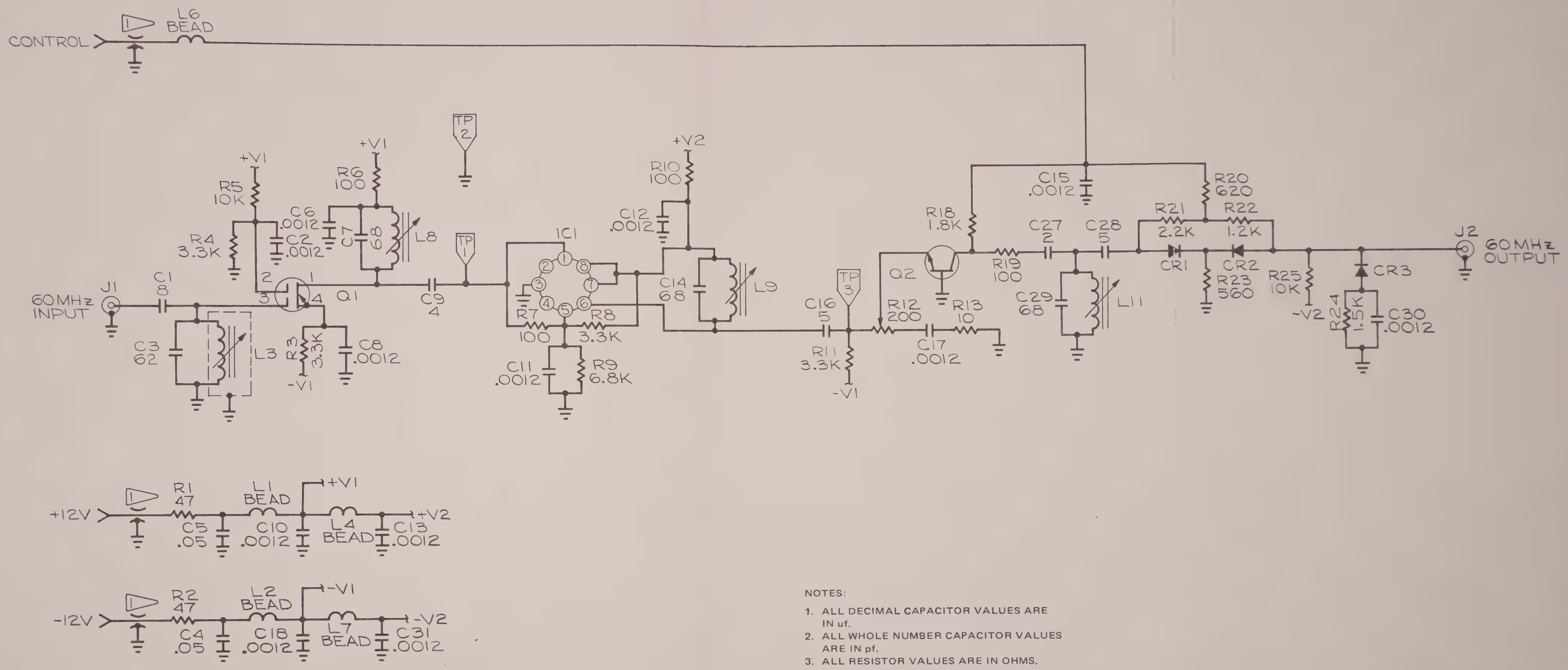
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

50 MHz HARMONIC SELECTOR MODULE

Drawing No. 645-1105 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


CONTROL
1
L6 BEAD
TP 2
TP 1
TP 3
+V1
R5 10K
R4 3.3K
R6 100
C6 .0012
C2 .0012
C7 68
L8
60MHz INPUT
J1
C1 8
C3 62
L3
Q1
2
1
3
4
R3 3.3K
-V1
C8 .0012
C9 4
IC1
1 2 3 4 5 6 7 8
R7 100
R8 3.3K
C11 .0012
R9 6.8K
+V2
R10 100
C12 .0012
C14 68
L9
C16 5
R11 3.3K
-V1
R12 200
C17 .0012
R13 10
Q2
R18 1.8K
R19 100
C15 .0012
C27 2
C28 5
C29 68
L11
R20 620
R21 2.2K
R22 1.2K
CR1
CR2
R23 560
R25 10K
-V2
CR3
R24 1.5K
C30 .0012
J2
60MHz OUTPUT
+12V
R1 47
C5 .05
L1 BEAD
C10 .0012
+V1
L4 BEAD
C13 .0012
+V2
-12V
R2 47
C4 .05
L2 BEAD
C18 .0012
-V1
L7 BEAD
C31 .0012
-V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

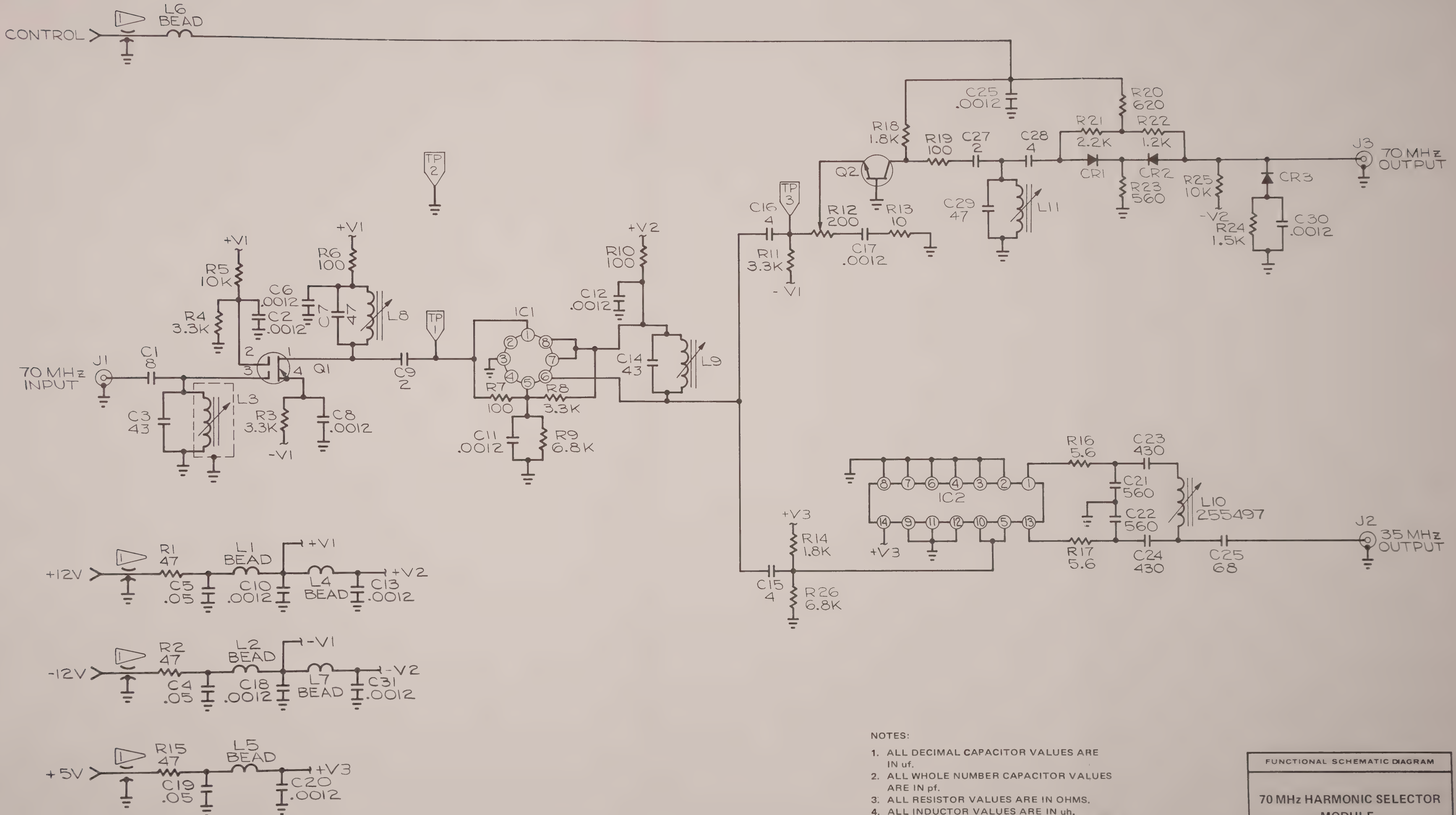
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

60 MHz HARMONIC SELECTOR MODULE

Drawing No. 645-1106 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


CONTROL
L6 BEAD
C25 .0012
R20 620
R18 1.8K
R19 100
C27 2
C28 4
R21 2.2K
R22 1.2K
J3
70 MHz OUTPUT
Q2
CR1
CR2
R23 560
R25 10K
CR3
TP 2
TP 3
C16 4
R12 200
R13 10
C29 47
L11
-V2
R24 1.5K
C30 .0012
R11 3.3K
C17 .0012
- V1
+V1
+V1
+V2
R5 10K
R6 100
R10 100
C6 .0012
C7 47
L8
C2 .0012
R4 3.3K
TP 1
IC1
C12 .0012
C14 43
L9
70 MHz INPUT
J1
C1 8
Q1
C9 2
R7 100
R8 3.3K
L3
C3 43
R3 3.3K
C8 .0012
-V1
C11 .0012
R9 6.8K
R16 5.6
C23 430
C21 560
IC2
L10 255497
C22 560
J2
35 MHz OUTPUT
+V3
R14 1.8K
+V3
R17 5.6
C24 430
C25 68
C15 4
R26 6.8K
+12V
R1 47
L1 BEAD
+V1
L4 BEAD
+V2
C5 .05
C10 .0012
C13 .0012
-12V
R2 47
L2 BEAD
-V1
L7 BEAD
-V2
C4 .05
C18 .0012
C31 .0012
+ 5V
R15 47
L5 BEAD
+V3
C19 .05
C20 .0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

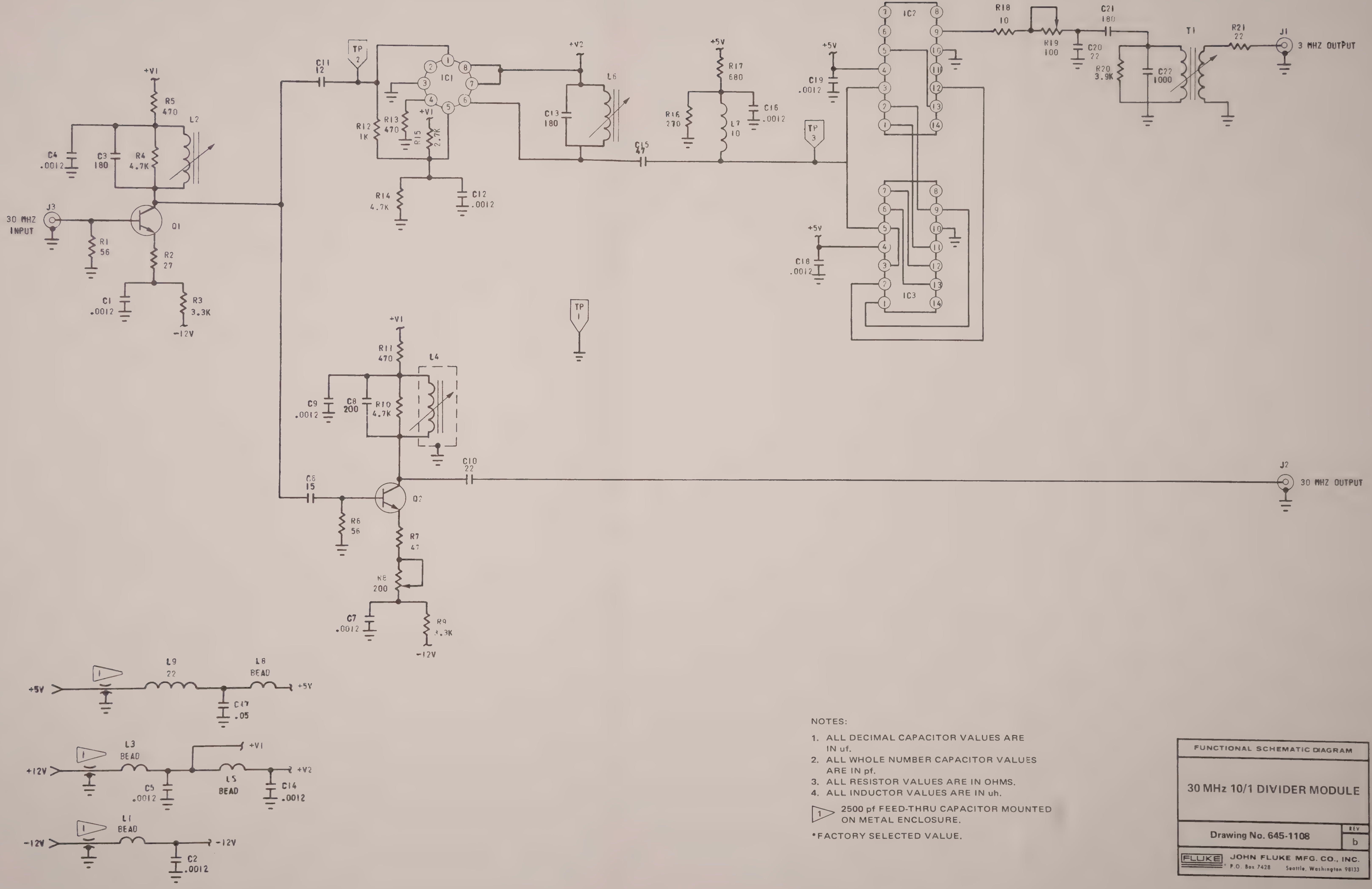
FUNCTIONAL SCHEMATIC DIAGRAM

70 MHz HARMONIC SELECTOR MODULE

Drawing No. 645-1107

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


30 MHZ INPUT
J3
R1 56
Q1
R2 27
C1 .0012
R3 3.3K
-12V
+V1
R5 470
C4 .0012
C3 180
R4 4.7K
L2
C11 12
TP 2
IC1
R12 1K
R13 470
R15
+V1
2.7K
R14 4.7K
C12 .0012
+V2
L6
C13 180
C15 47
+5V
R17 680
R16 270
L7 10
C16 .0012
TP 3
+5V
C19 .0012
IC2
IC3
+5V
C18 .0012
R18 10
R19 100
C21 180
C20 22
R20 3.9K
C22 1000
T1
R21 22
J1
3 MHZ OUTPUT
TP 1
+V1
R11 470
L4
C9 .0012
C8 200
R10 4.7K
C10 22
J2
30 MHZ OUTPUT
C6 15
Q2
R6 56
R7 47
R8 200
C7 .0012
R9 3.3K
-12V
+5V
L9 22
L8 BEAD
+5V
C47 .05
+12V
L3 BEAD
+V1
C5 .0012
L5 BEAD
+V2
C14 .0012
-12V
L1 BEAD
-12V
C2 .0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

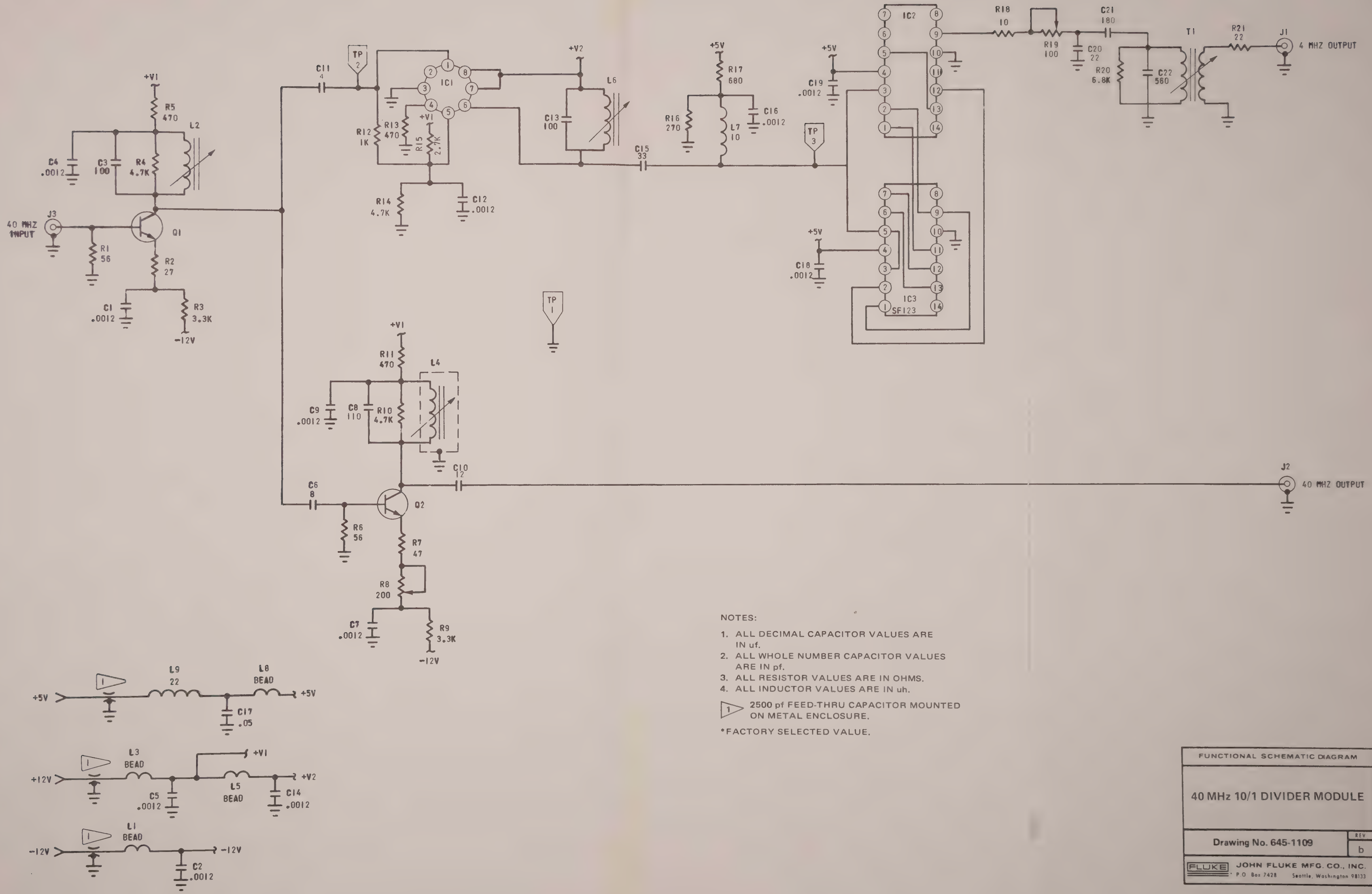
30 MHz 10/1 DIVIDER MODULE

Drawing No. 645-1108

REV b

25

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
R5
470
L2
C4
.0012
C3
100
R4
4.7K
J3
40 MHZ
INPUT
Q1
R1
56
R2
27
C1
.0012
R3
3.3K
-12V
C11
4
TP
2
IC1
R12
1K
R13
470
+V1
R15
2.7K
R14
4.7K
C12
.0012
+V2
L6
C13
100
C15
33
+5V
R17
680
R16
270
L7
10
C16
.0012
TP
3
+5V
C19
.0012
IC2
R18
10
R19
100
C20
22
C21
180
R20
6.8K
C22
560
T1
R21
22
J1
4 MHZ OUTPUT
+5V
C18
.0012
IC3
SF123
TP
1
+V1
R11
470
L4
C9
.0012
C8
110
R10
4.7K
C10
12
J2
40 MHZ OUTPUT
C6
8
Q2
R6
56
R7
47
R8
200
C7
.0012
R9
3.3K
-12V
L9
22
L8
BEAD
+5V
+5V
C17
.05
L3
BEAD
+V1
+12V
L5
BEAD
+V2
C5
.0012
C14
.0012
L1
BEAD
-12V
-12V
C2
.0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

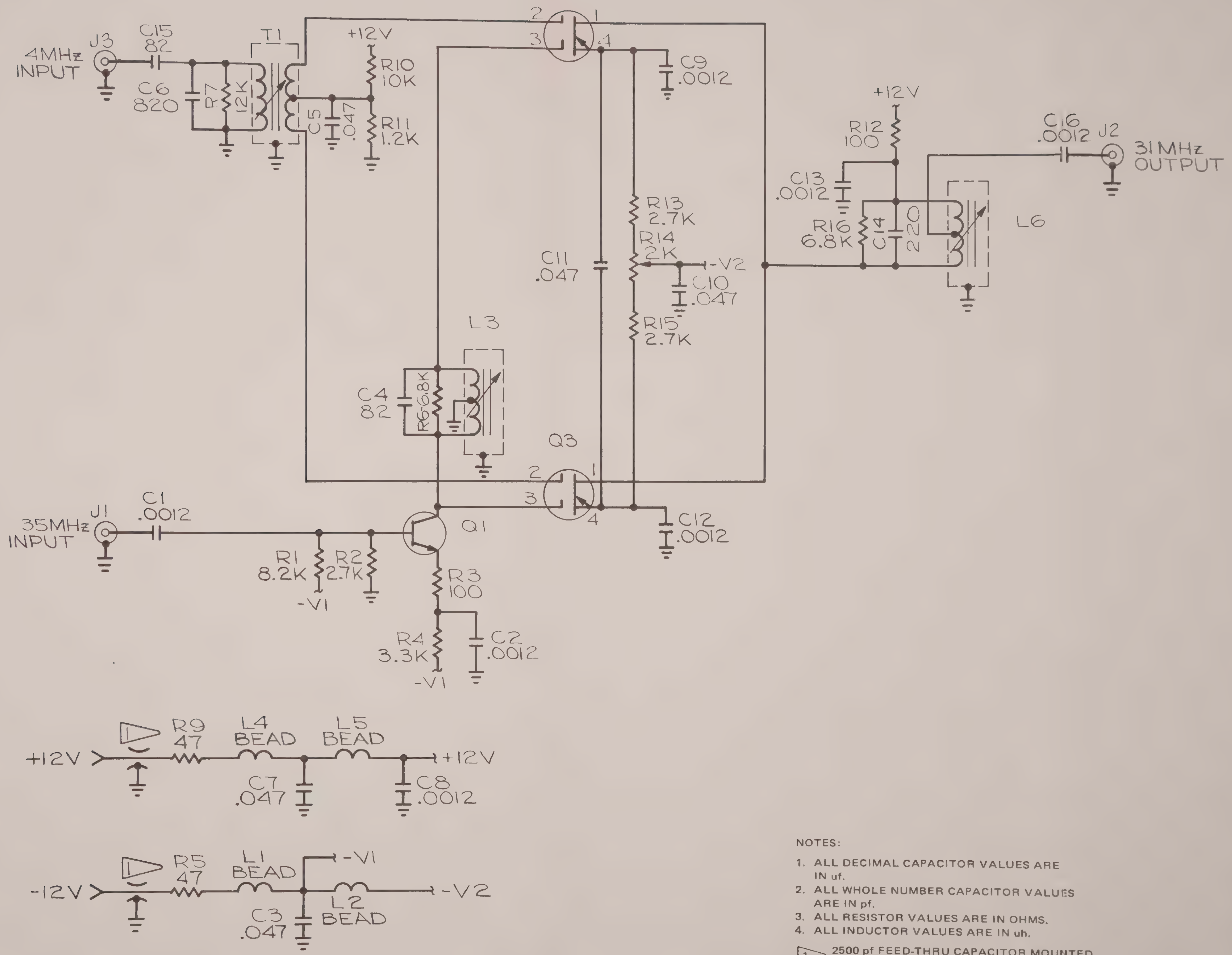
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

40 MHz 10/1 DIVIDER MODULE

Drawing No. 645-1109 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


J3
C15
82
4MHz
INPUT
C6
820
R7
12K
T1
C5
.047
+12V
R10
10K
R11
1.2K
2
1
3
4
C9
.0012
+12V
R12
100
C16
.0012
J2
31MHz
OUTPUT
C13
.0012
R16
6.8K
C14
220
L6
R13
2.7K
R14
2K
-V2
C10
.047
C11
.047
R15
2.7K
L3
C4
82
R6 6.8K
Q3
2
1
3
4
C12
.0012
J1
C1
.0012
35MHz
INPUT
Q1
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
R9
47
L4
BEAD
L5
BEAD
+12V
+12V
C7
.047
C8
.0012
R5
47
L1
BEAD
-V1
-12V
-V2
L2
BEAD
C3
.047
1

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

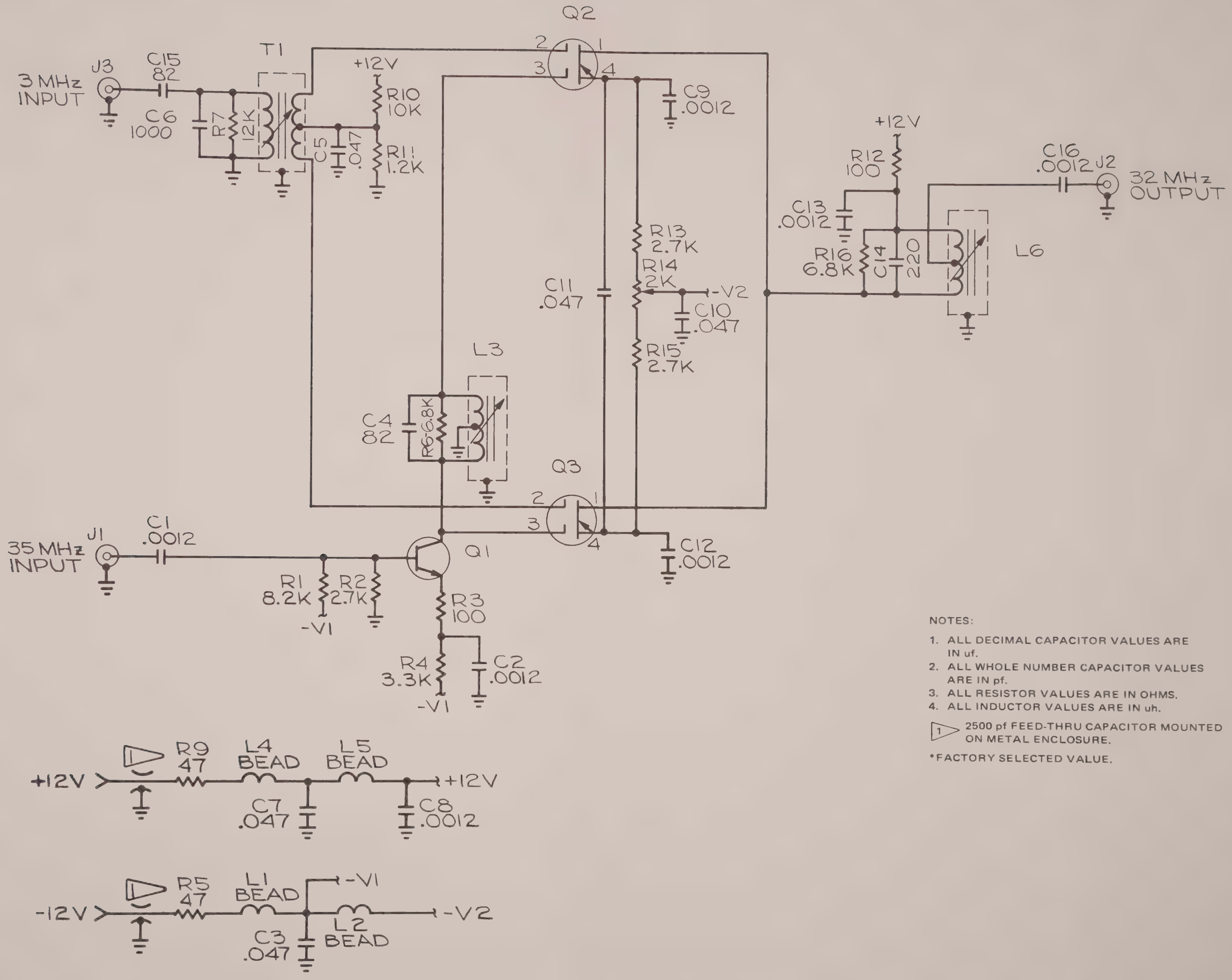
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

31 MHz MIXER MODULE

Drawing No. 645-1121 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
Q3
Q1
T1
J3
3 MHz INPUT
C15 82
C6 1000
R7 12K
C5 .047
+12V
R10 10K
R11 1.2K
C9 .0012
R13 2.7K
R14 2K
-V2
C10 .047
C11 .047
R15 2.7K
L3
C4 82
R6 6.8K
J1
35 MHz INPUT
C1 .0012
R1 8.2K
R2 2.7K
-V1
R3 100
R4 3.3K
C2 .0012
C12 .0012
+12V
R12 100
C13 .0012
R16 6.8K
C14 220
L6
C16 .0012
J2
32 MHz OUTPUT
+12V
R9 47
L4 BEAD
L5 BEAD
+12V
C7 .047
C8 .0012
-12V
R5 47
L1 BEAD
-V1
L2 BEAD
-V2
C3 .047
1
1
2
3
4
1
2
3
4

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

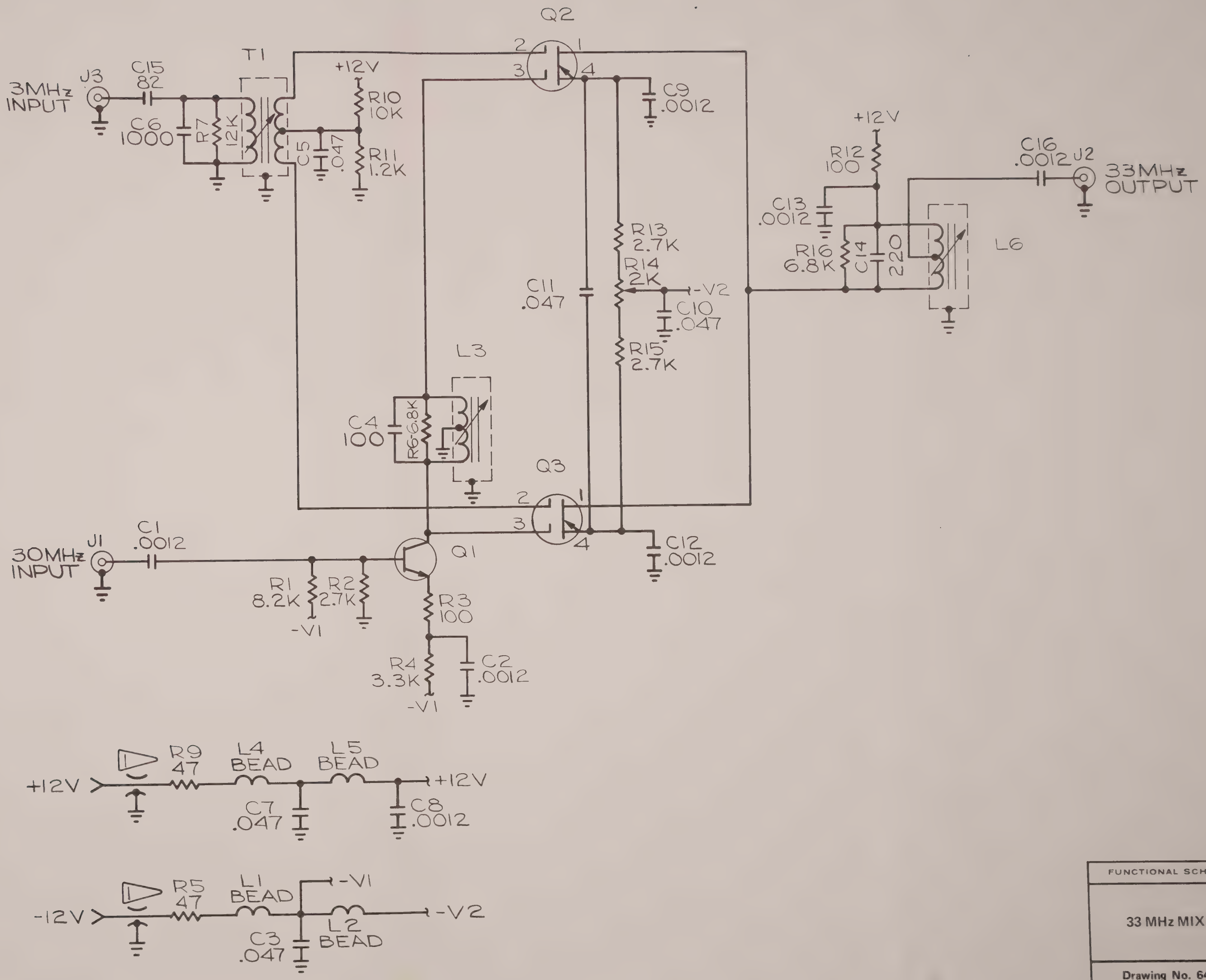
FUNCTIONAL SCHEMATIC DIAGRAM

32 MHz MIXER MODULE

Drawing No. 645-1122

REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
2
1
3
4
C9
.0012
3MHz INPUT
J3
C15
82
T1
+12V
R10
10K
C6
1000
R7
12K
C5
.047
R11
1.2K
+12V
R12
100
C16
.0012
J2
33MHz OUTPUT
C13
.0012
R16
6.8K
C14
220
L6
R13
2.7K
R14
2K
-V2
C11
.047
C10
.047
R15
2.7K
L3
C4
100
R6 6.8K
Q3
2
1
3
4
C12
.0012
30MHz INPUT
J1
C1
.0012
Q1
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
+12V
R9
47
L4
BEAD
L5
BEAD
+12V
C7
.047
C8
.0012
-12V
R5
47
L1
BEAD
-V1
-V2
L2
BEAD
C3
.047

FUNCTIONAL SCHEMATIC DIAGRAM

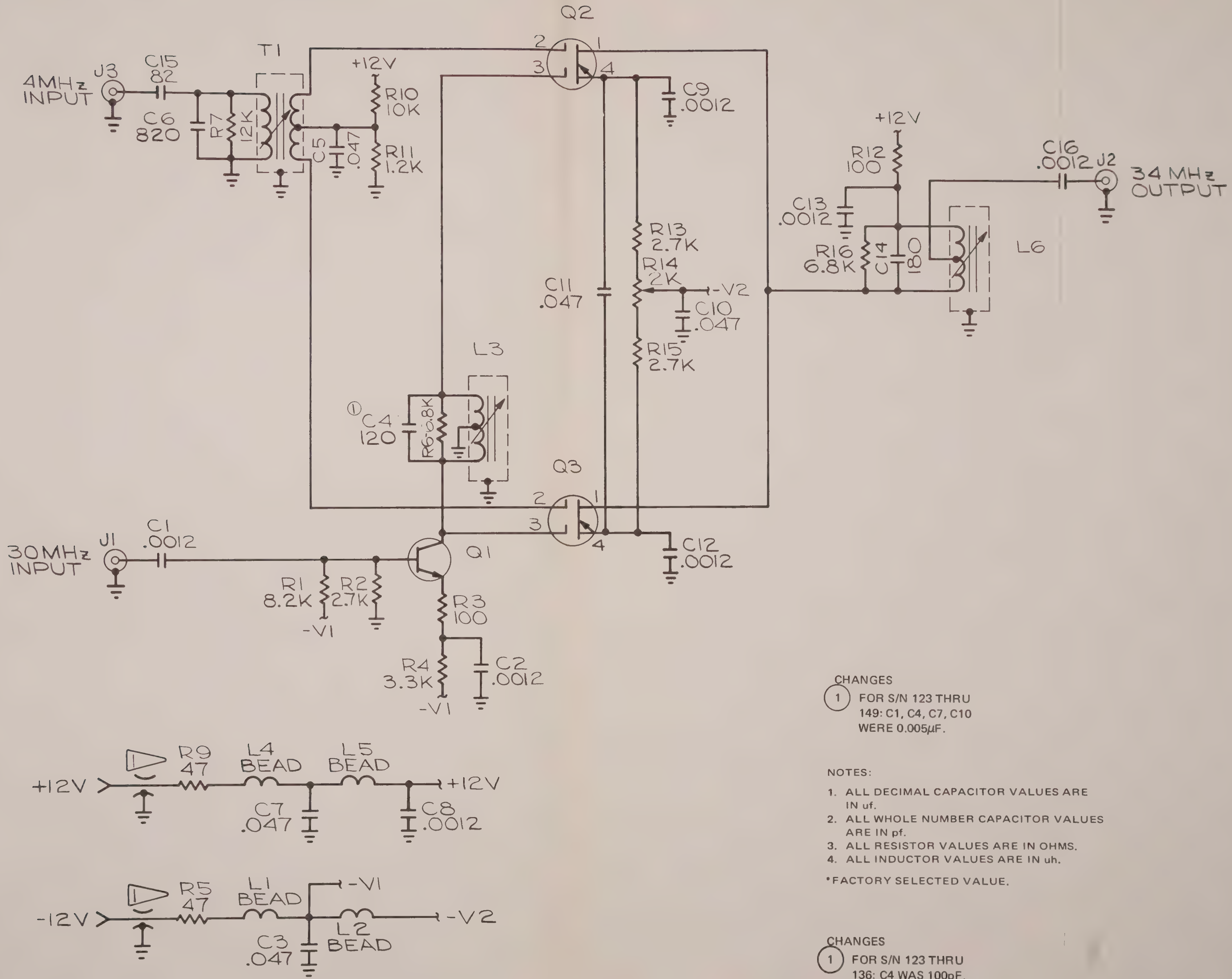
33 MHz MIXER MODULE

Drawing No. 645-1123

REV
b

29

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
2
1
3
4
T1
+12V
C15
82
4MHz
INPUT
J3
C6
820
R7
12K
C5
.047
R10
10K
R11
1.2K
C9
.0012
+12V
R12
100
C16
.0012
J2
34 MHz
OUTPUT
C13
.0012
R16
6.8K
C14
180
L6
R13
2.7K
R14
2K
-V2
C11
.047
C10
.047
R15
2.7K
L3
①
C4
120
R6
6.8K
Q3
2
1
3
4
C1
.0012
J1
30MHz
INPUT
Q1
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
C12
.0012
R9
47
L4
BEAD
L5
BEAD
+12V
+12V
C7
.047
C8
.0012
R5
47
L1
BEAD
-V1
-12V
-V2
C3
.047
L2
BEAD

CHANGES

① FOR S/N 123 THRU 149: C1, C4, C7, C10 WERE 0.005μF.

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

CHANGES

① FOR S/N 123 THRU 136: C4 WAS 100pF.

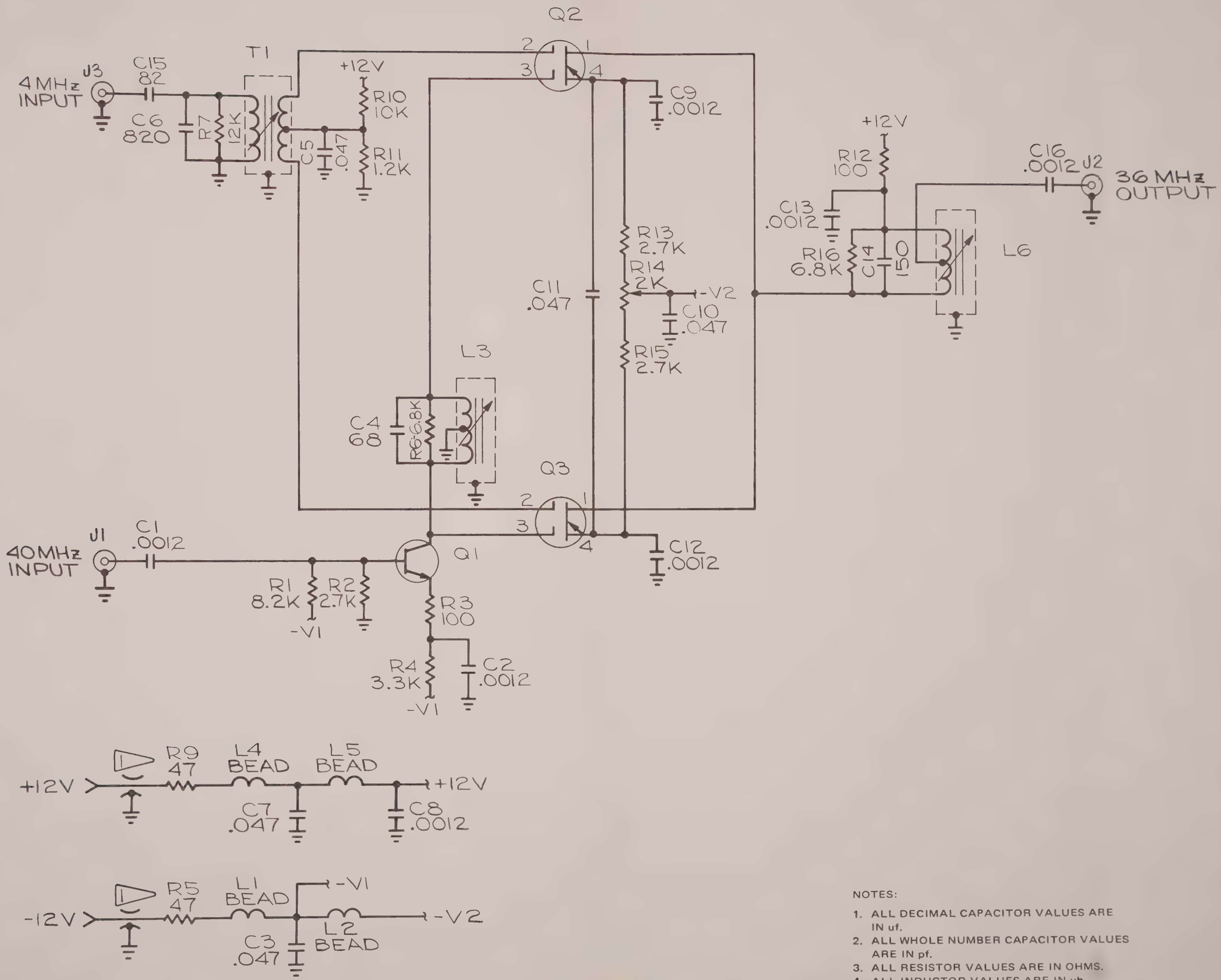
FUNCTIONAL SCHEMATIC DIAGRAM

34 MHz MIXER MODULE

Drawing No. 645-1124

REV.
C

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
T1
C15
82
J3
4 MHz
INPUT
C6
820
R7
12K
C5
.047
+12V
R10
10K
R11
1.2K
2
1
3
4
C9
.0012
+12V
R12
100
C16
.0012
J2
36 MHz
OUTPUT
C13
.0012
R16
6.8K
C14
150
L6
R13
2.7K
R14
2K
-V2
C11
.047
C10
.047
R15
2.7K
L3
C4
68
R6 6.8K
Q3
2
1
3
4
J1
C1
.0012
40MHz
INPUT
Q1
C12
.0012
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
1
R9
47
L4
BEAD
L5
BEAD
+12V
+12V
C7
.047
C8
.0012
1
R5
47
L1
BEAD
-V1
-12V
-V2
C3
.047
L2
BEAD

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

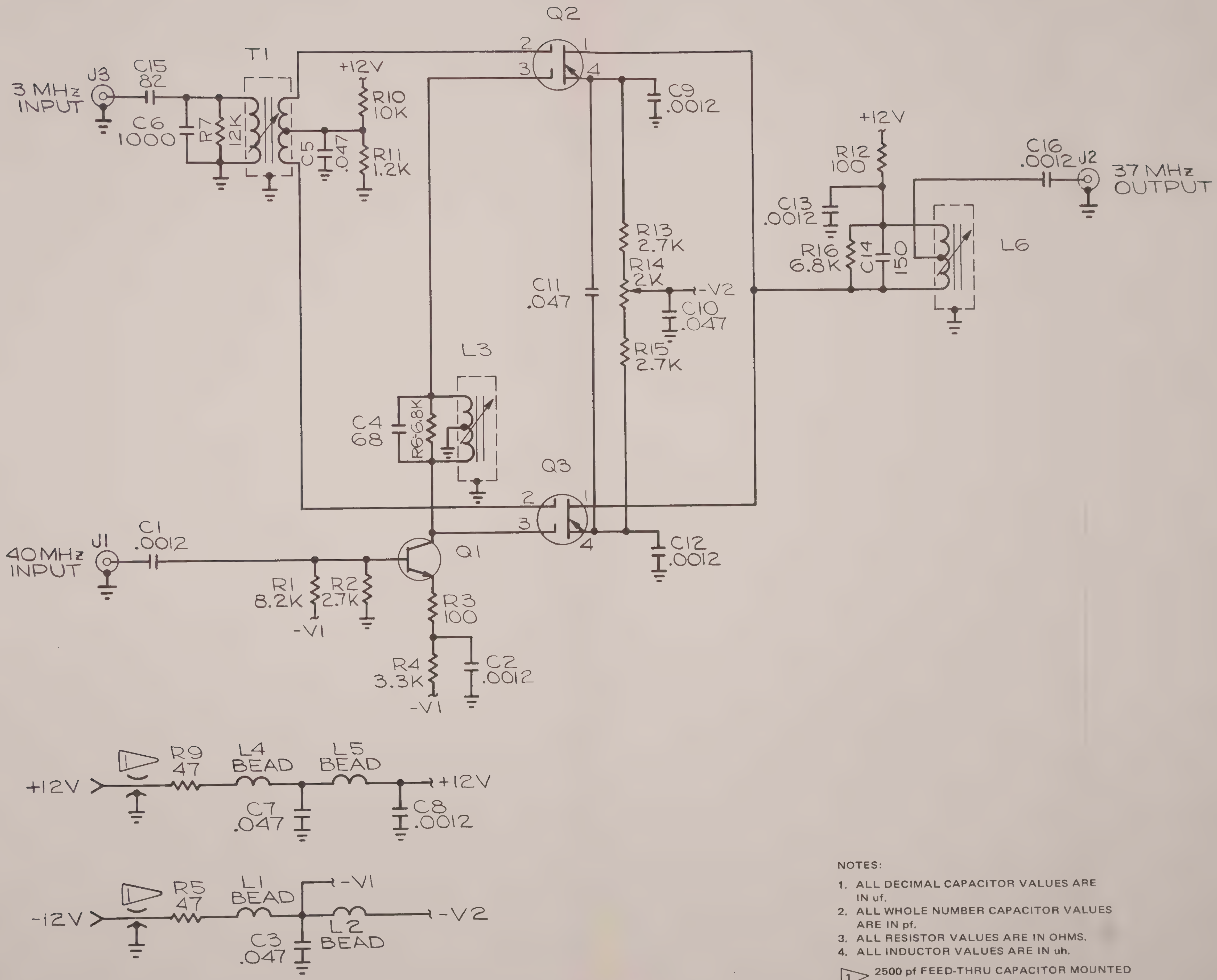
FUNCTIONAL SCHEMATIC DIAGRAM

36 MHz MIXER MODULE

Drawing No. 645-1125

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
2
1
3
4
T1
J3
C15
82
3 MHz
INPUT
C6
1000
R7
12K
+12V
R10
10K
C5
.047
R11
1.2K
C9
.0012
+12V
R12
100
C16
.0012
J2
37 MHz
OUTPUT
C13
.0012
R13
2.7K
R14
2K
-V2
C10
.047
C11
.047
R16
6.8K
C14
150
L6
R15
2.7K
L3
C4
68
R6 6.8K
Q3
2
1
3
4
C12
.0012
J1
C1
.0012
40MHz
INPUT
Q1
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
+12V
1
R9
47
L4
BEAD
L5
BEAD
+12V
C7
.047
C8
.0012
-12V
1
R5
47
L1
BEAD
-V1
-V2
C3
.047
L2
BEAD

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

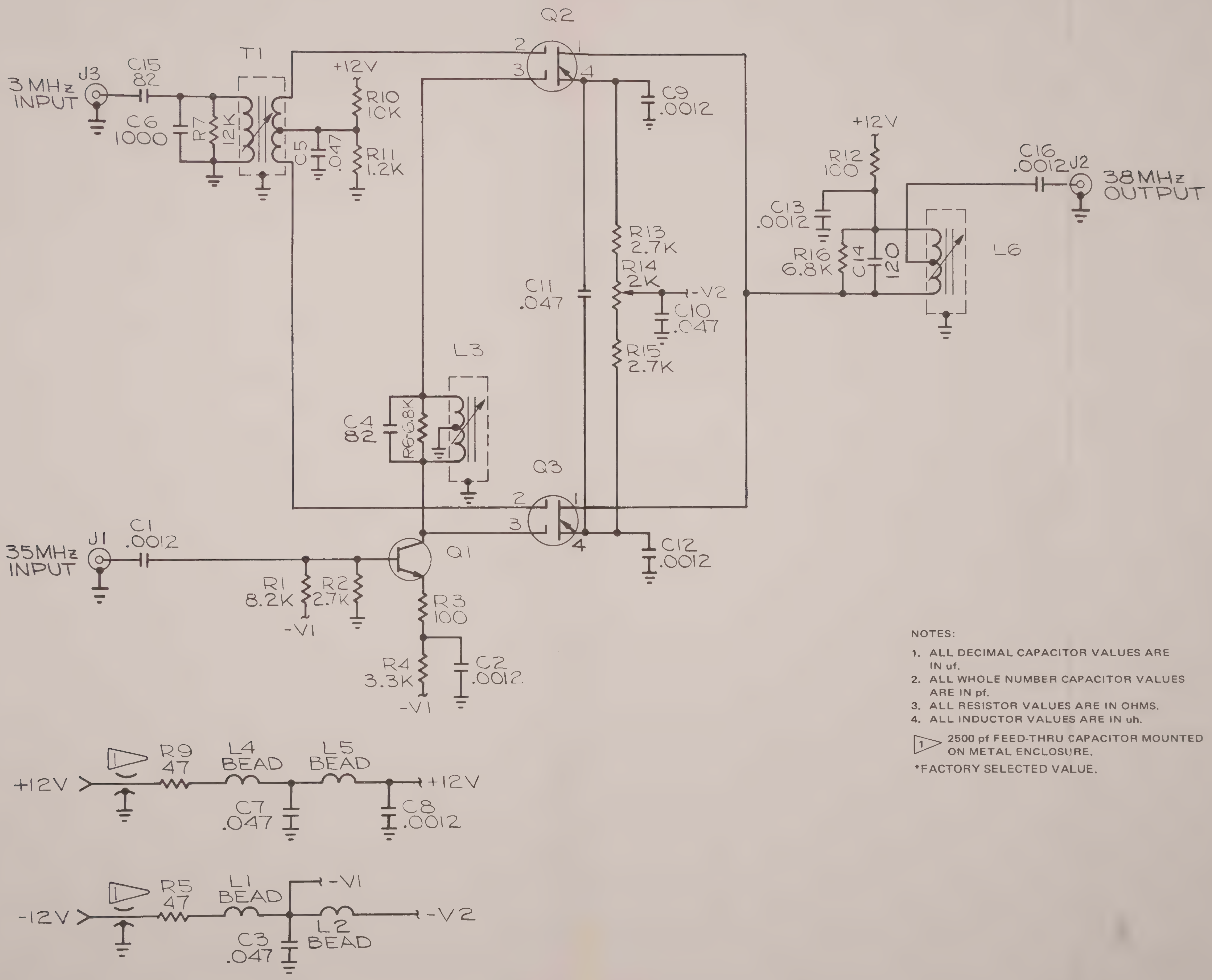
37 MHz MIXER MODULE

Drawing No. 645-1126

REV
b

32

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
2
1
3
4
3 MHz INPUT
J3
C15 82
T1
+12V
R10 10K
C9 .0012
C6 1000
R7 12K
C5 .047
R11 1.2K
+12V
R12 100
C16 .0012
J2
38 MHz OUTPUT
C13 .0012
R13 2.7K
R14 2K
-V2
L6
R16 6.8K
C14 120
C11 .047
C10 .047
R15 2.7K
L3
C4 82
R6 6.8K
Q3
2
1
3
4
C1 .0012
J1
35 MHz INPUT
Q1
C12 .0012
R1 8.2K
R2 2.7K
-V1
R3 100
R4 3.3K
C2 .0012
-V1
R9 47
L4 BEAD
L5 BEAD
+12V
+12V
C7 .047
C8 .0012
R5 47
L1 BEAD
-V1
-12V
-V2
L2 BEAD
C3 .047
1
1

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

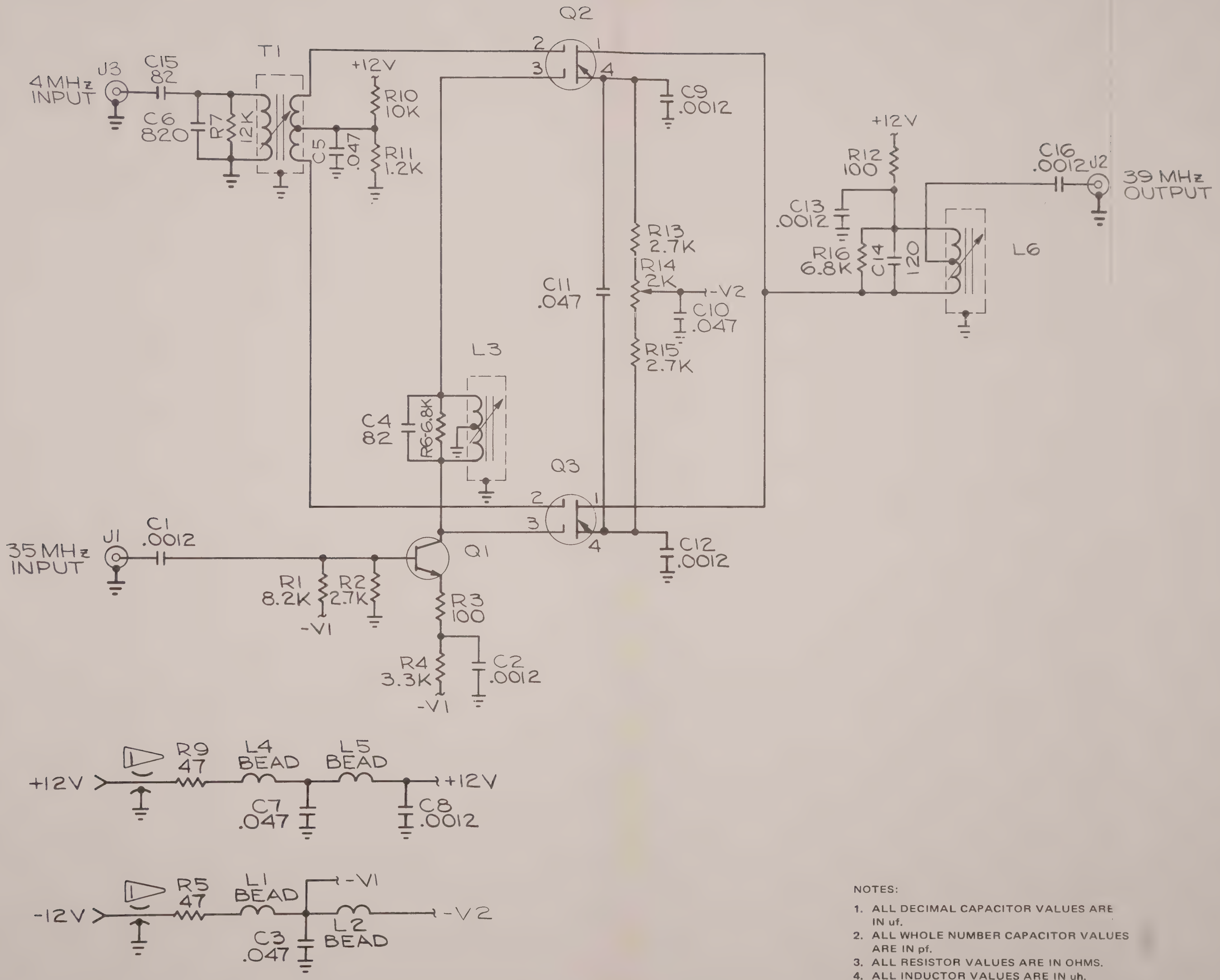
FUNCTIONAL SCHEMATIC DIAGRAM

38 MHz MIXER MODULE

Drawing No. 645-1127

REV.
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


Q2
T1
J3
C15
82
4 MHz
INPUT
C6
820
R7
12K
+12V
R10
10K
C5
.047
R11
1.2K
C9
.0012
+12V
R12
100
C16
.0012
J2
39 MHz
OUTPUT
C13
.0012
R13
2.7K
R14
2K
-V2
R16
6.8K
C14
120
L6
C11
.047
C10
.047
R15
2.7K
L3
C4
82
R6 6.8K
Q3
C1
.0012
J1
35 MHz
INPUT
Q1
C12
.0012
R1
8.2K
R2
2.7K
-V1
R3
100
R4
3.3K
C2
.0012
-V1
1
2
3
4
R9
47
L4
BEAD
L5
BEAD
+12V
+12V
C7
.047
C8
.0012
R5
47
L1
BEAD
-V1
-12V
-V2
C3
.047
L2
BEAD

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

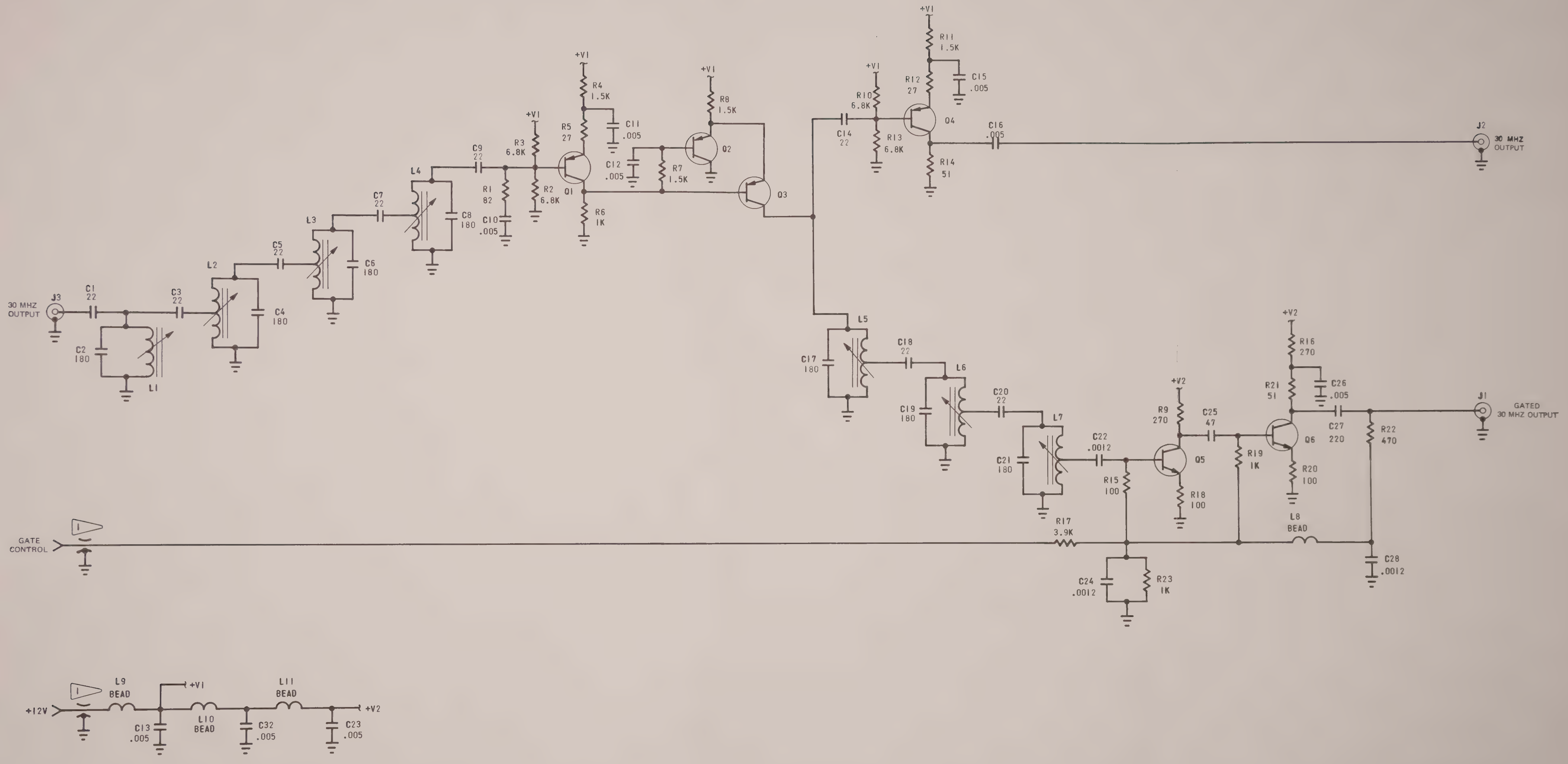
FUNCTIONAL SCHEMATIC DIAGRAM

39 MHz MIXER MODULE

Drawing No. 645-1128

REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


30 MHZ OUTPUT
J3
C1 22
C3 22
C2 180
L1
L2
C4 180
C5 22
L3
C6 180
C7 22
L4
C8 180
C9 22
R1 82
C10 .005
+V1
R3 6.8K
R2 6.8K
R5 27
+V1
R4 1.5K
C11 .005
Q1
R6 1K
C12 .005
R7 1.5K
+V1
R8 1.5K
Q2
Q3
+V1
R10 6.8K
C14 22
R13 6.8K
+V1
R11 1.5K
R12 27
C15 .005
Q4
C16 .005
R14 51
J2
30 MHZ OUTPUT
L5
C17 180
C18 22
L6
C19 180
C20 22
L7
C21 180
C22 .0012
R15 100
+V2
R9 270
Q5
R18 100
C25 47
R19 1K
+V2
R16 270
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
J1
GATED 30 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C24 .0012
R23 1K
C28 .0012
+12V
1
L9 BEAD
+V1
C13 .005
L10 BEAD
C32 .005
L11 BEAD
+V2
C23 .005

NOTES:

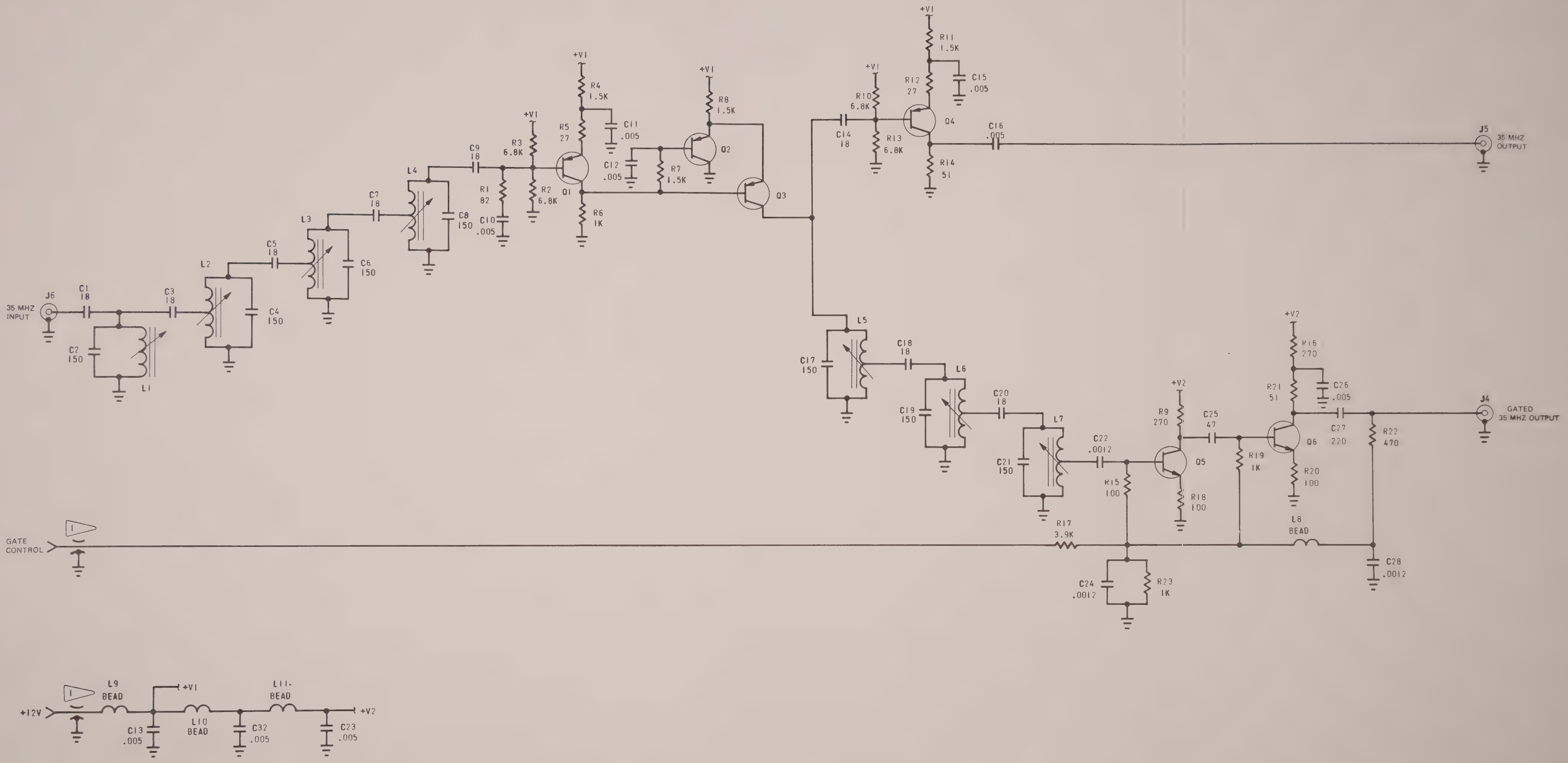
1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM	
30/35 MHz FILTER MODULE	
Drawing No. 645-1129-1 (1 of 2)	REV b
FLUKE JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133	

35



35 MHZ INPUT
J6
C1 18
C2 150
L1
C3 18
L2
C4 150
C5 18
L3
C6 150
C7 18
L4
C8 150
C9 18
R1 82
C10 .005
+V1
R3 6.8K
R2 6.8K
R5 27
Q1
+V1
R4 1.5K
C11 .005
R6 1K
C12 .005
R7 1.5K
+V1
R8 1.5K
Q2
Q3
+V1
R10 6.8K
C14 18
R13 6.8K
+V1
R11 1.5K
R12 27
C15 .005
Q4
R14 51
C16 .005
J5
35 MHZ OUTPUT
L5
C17 150
C18 18
L6
C19 150
C20 18
L7
C21 150
C22 .0012
R15 100
+V2
R9 270
Q5
R18 100
C25 47
R19 1K
+V2
R16 270
R21 51
C26 .005
Q6
R20 100
C27 270
R22 470
J4
GATED 35 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C24 .0012
R23 1K
C28 .0012
+12V
1
L9 BEAD
+V1
C13 .005
L10 BEAD
C32 .005
L11 BEAD
C23 .005
+V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE

FUNCTIONAL SCHEMATIC DIAGRAM

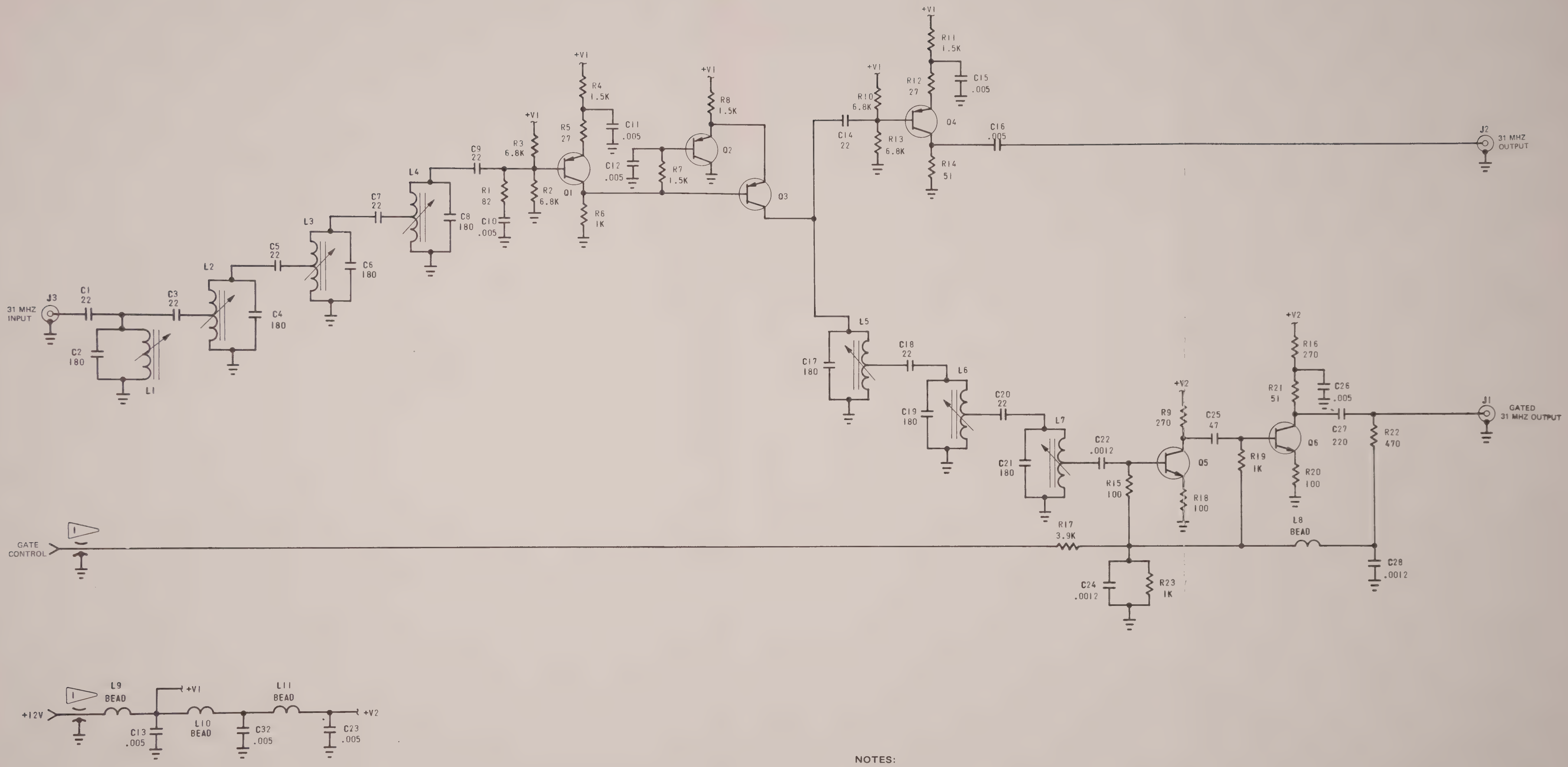
30/35 MHz FILTER MODULE

Drawing No. 645-1129-1 (2 of 2)

REV b

36

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133



31 MHZ INPUT
J3
C1 22
C2 180
L1
C3 22
L2
C4 180
C5 22
L3
C6 180
C7 22
L4
C8 180
C9 22
R1 82
C10 .005
R3 6.8K
+V1
R2 6.8K
R5 27
Q1
R4 1.5K
+V1
C11 .005
R6 1K
C12 .005
R7 1.5K
Q2
R8 1.5K
+V1
Q3
C14 22
R10 6.8K
+V1
R13 6.8K
R12 27
R11 1.5K
+V1
C15 .005
Q4
R14 51
C16 .005
J2
31 MHZ OUTPUT
L5
C17 180
C18 22
L6
C19 180
C20 22
L7
C21 180
C22 .0012
R15 100
R9 270
+V2
Q5
R18 100
C25 47
R19 1K
R16 270
+V2
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
J1
GATED 31 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C24 .0012
R23 1K
C28 .0012
+12V
1
L9 BEAD
+V1
C13 .005
L10 BEAD
C32 .005
L11 BEAD
+V2
C23 .005

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

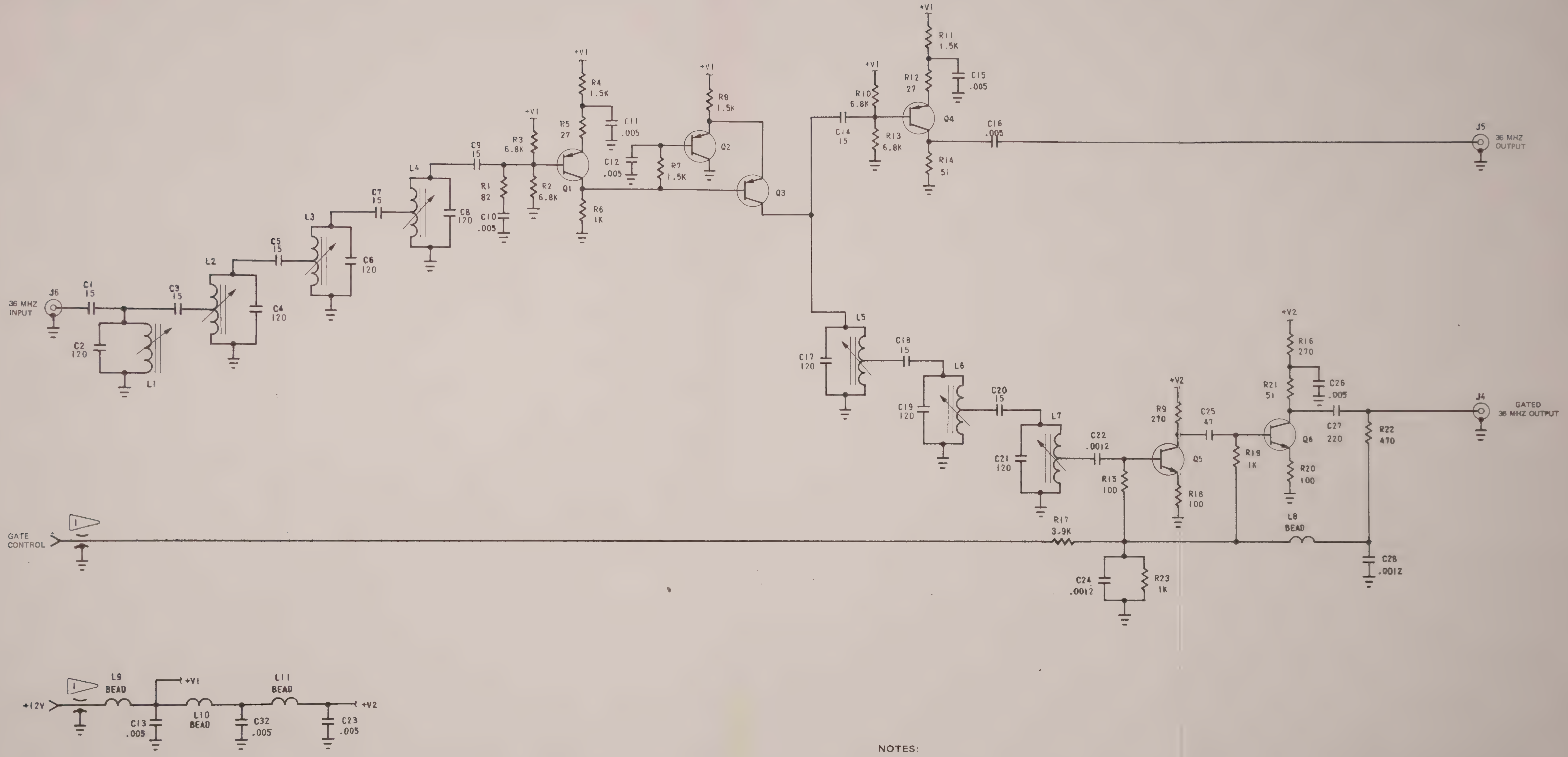
*FACTORY SELECTED VALUE

FUNCTIONAL SCHEMATIC DIAGRAM

31/36 MHz FILTER MODULE

Drawing No. 645-1129-2 (1 of 2) REV. b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


36 MHZ INPUT
J6
C1 15
C2 120
L1
C3 15
L2
C4 120
C5 15
L3
C6 120
C7 15
L4
C8 120
C9 15
R1 82
C10 .005
R3 6.8K
+V1
R2 6.8K
R5 27
Q1
R4 1.5K
C11 .005
R6 1K
C12 .005
R7 1.5K
Q2
R8 1.5K
Q3
C14 15
R10 6.8K
R13 6.8K
R12 27
R11 1.5K
C15 .005
Q4
R14 51
C16 .005
J5
36 MHZ OUTPUT
L5
C17 120
C18 15
L6
C19 120
C20 15
L7
C21 120
C22 .0012
R15 100
R9 270
+V2
Q5
R18 100
C25 47
R19 1K
R16 270
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
J4
GATED 36 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C24 .0012
R23 1K
C28 .0012
+12V
L9 BEAD
C13 .005
L10 BEAD
C32 .005
L11 BEAD
C23 .005

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

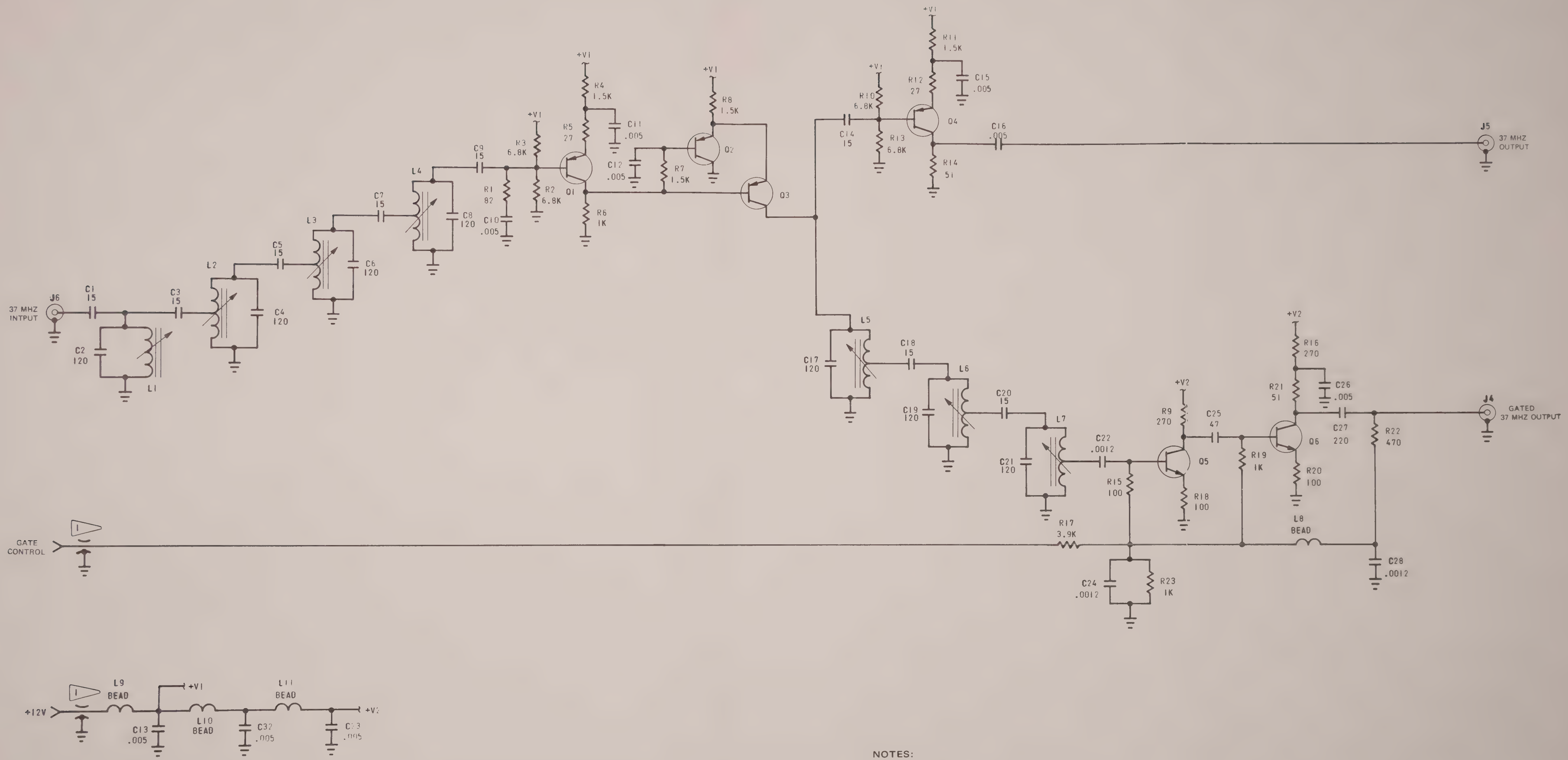
31/36 MHz FILTER MODULE

Drawing No. 645-1129-2 (2 of 2)

REV b

38

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


37 MHZ INPUT
J6
C1 15
C2 120
L1
C3 15
L2
C4 120
C5 15
L3
C6 120
C7 15
L4
C8 120
C9 15
R1 82
C10 .005
R3 6.8K
R2 6.8K
+V1
R4 1.5K
R5 27
C11 .005
Q1
R6 1K
R8 1.5K
Q2
C12 .005
R7 1.5K
Q3
R10 6.8K
C14 15
R13 6.8K
R11 1.5K
C15 .005
R12 27
Q4
R14 51
C16 .005
J5
37 MHZ OUTPUT
L5
C17 120
C18 15
L6
C19 120
C20 15
L7
C21 120
C22 .0012
R15 100
Q5
R9 270
+V2
R18 100
C25 47
R19 1K
R16 270
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
J4
GATED 37 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C28 .0012
C24 .0012
R23 1K
+12V
L9 BEAD
C13 .005
L10 BEAD
C37 .005
L11 BEAD
C33 .005
+V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

△1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

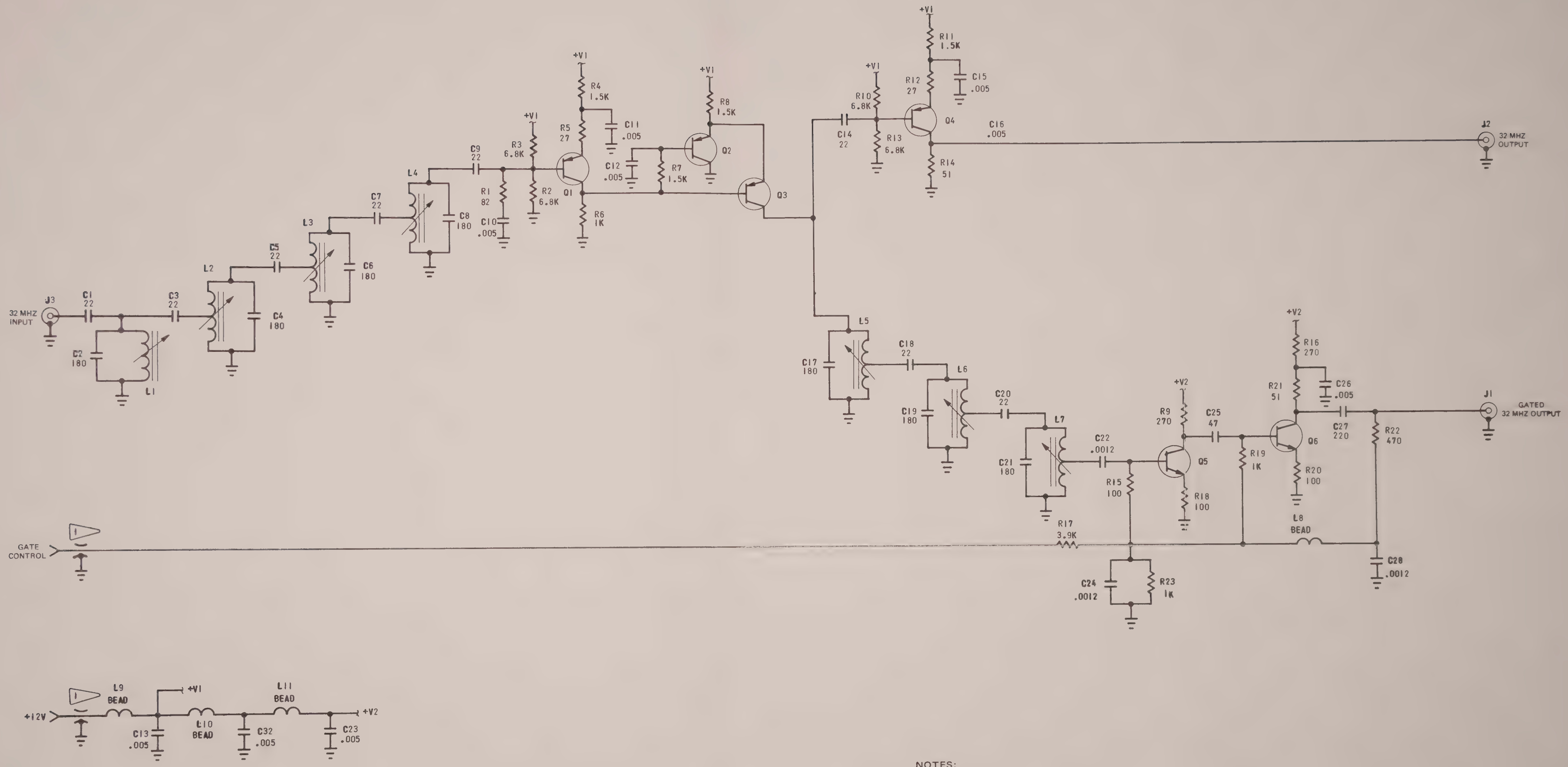
FUNCTIONAL SCHEMATIC DIAGRAM

32/37 MHz FILTER MODULE

Drawing No. 645-1129-3 (1 of 2)

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


J3
32 MHZ INPUT
C1 22
C2 180
L1
C3 22
L2
C4 180
C5 22
L3
C6 180
C7 22
L4
C8 180
C9 22
R1 82
C10 .005
R3 6.8K
R2 6.8K
+V1
R5 27
Q1
R4 1.5K
C11 .005
R6 1K
+V1
R8 1.5K
Q2
C12 .005
R7 1.5K
Q3
C14 22
+V1
R10 6.8K
R13 6.8K
+V1
R11 1.5K
R12 27
C15 .005
Q4
R14 51
C16 .005
J2
32 MHZ OUTPUT
L5
C17 180
C18 22
L6
C19 180
C20 22
L7
C21 180
C22 .0012
R15 100
+V2
R9 270
C25 47
Q5
R18 100
R19 1K
+V2
R16 270
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
J1
GATED 32 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C28 .0012
C24 .0012
R23 1K
+12V
1
L9 BEAD
C13 .005
+V1
L10 BEAD
C32 .005
L11 BEAD
+V2
C23 .005

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

△1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

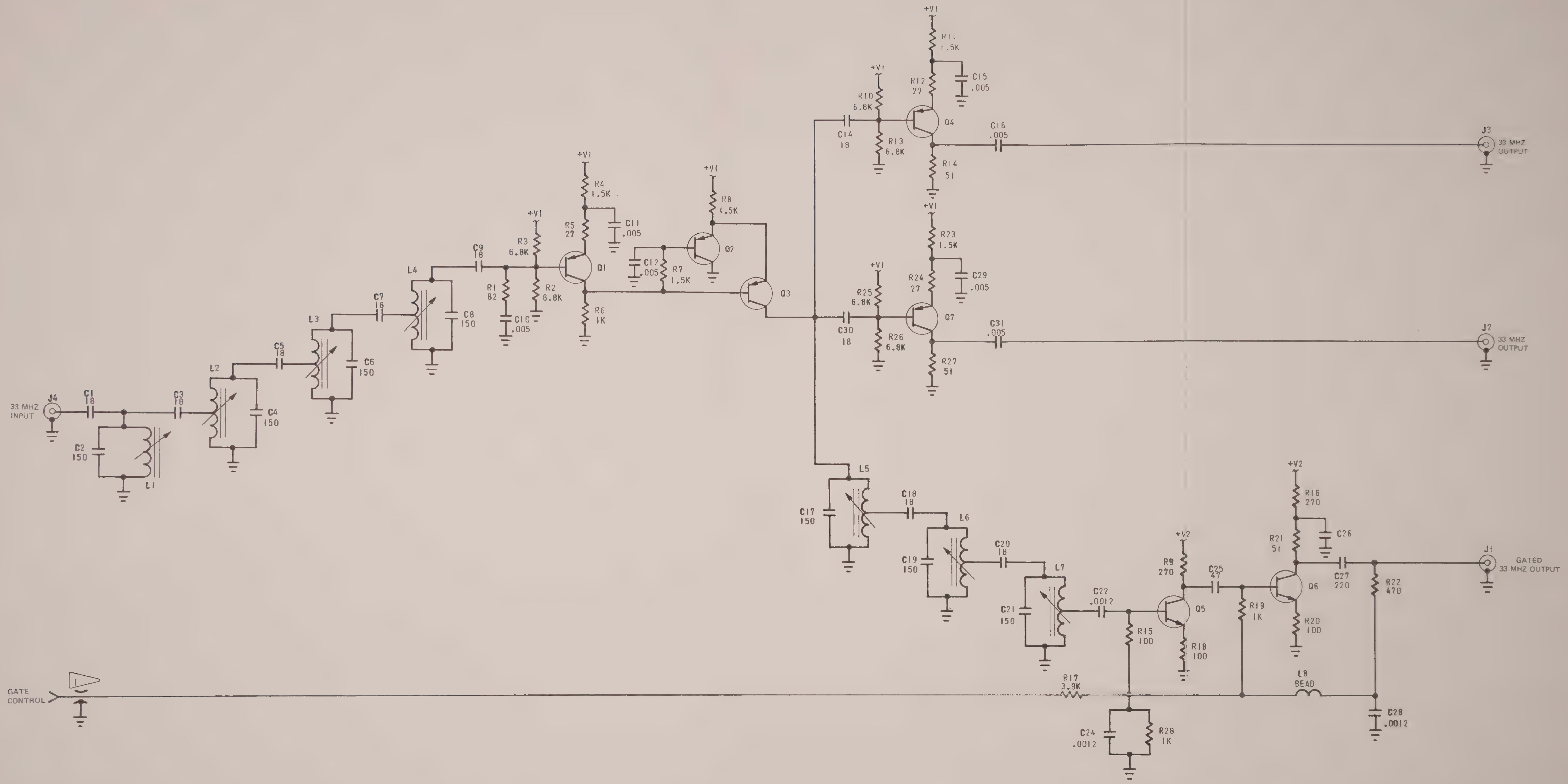
*FACTORY SELECTED VALUE.

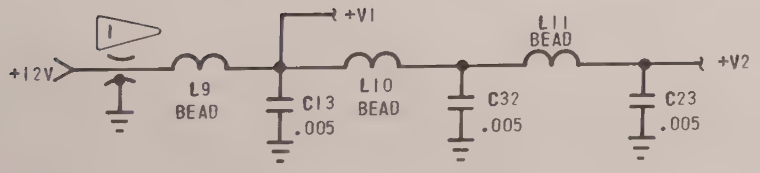
FUNCTIONAL SCHEMATIC DIAGRAM

32/37 MHz FILTER MODULE

Drawing No. 645-1129-3 (2 of 2)
REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
R11 1.5K
C15 .005
+V1
R12 27
R10 6.8K
C14 18
R13 6.8K
Q4
C16 .005
R14 51
J3
33 MHZ OUTPUT
+V1
R23 1.5K
C29 .005
+V1
R24 27
R25 6.8K
C30 18
R26 6.8K
Q7
C31 .005
R27 51
J2
33 MHZ OUTPUT
+V1
R4 1.5K
C11 .005
+V1
R8 1.5K
Q2
+V1
R5 27
R3 6.8K
C9 18
Q1
C12 .005
R7 1.5K
Q3
L4
R1 82
R2 6.8K
C10 .005
R6 1K
C7 18
C8 150
L3
C5 18
C6 150
L2
C4 150
33 MHZ INPUT
J4
C1 18
C3 18
C2 150
L1
L5
C17 150
C18 18
L6
C19 150
C20 18
L7
C21 150
C22 .0012
+V2
R9 270
C25 47
Q5
R15 100
R18 100
R19 1K
+V2
R16 270
C26
R21 51
Q6
R20 100
C27 220
R22 470
J1
GATED 33 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C28 .0012
C24 .0012
R28 1K


1
+12V
L9 BEAD
+V1
C13 .005
L10 BEAD
C32 .005
L11 BEAD
+V2
C23 .005

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

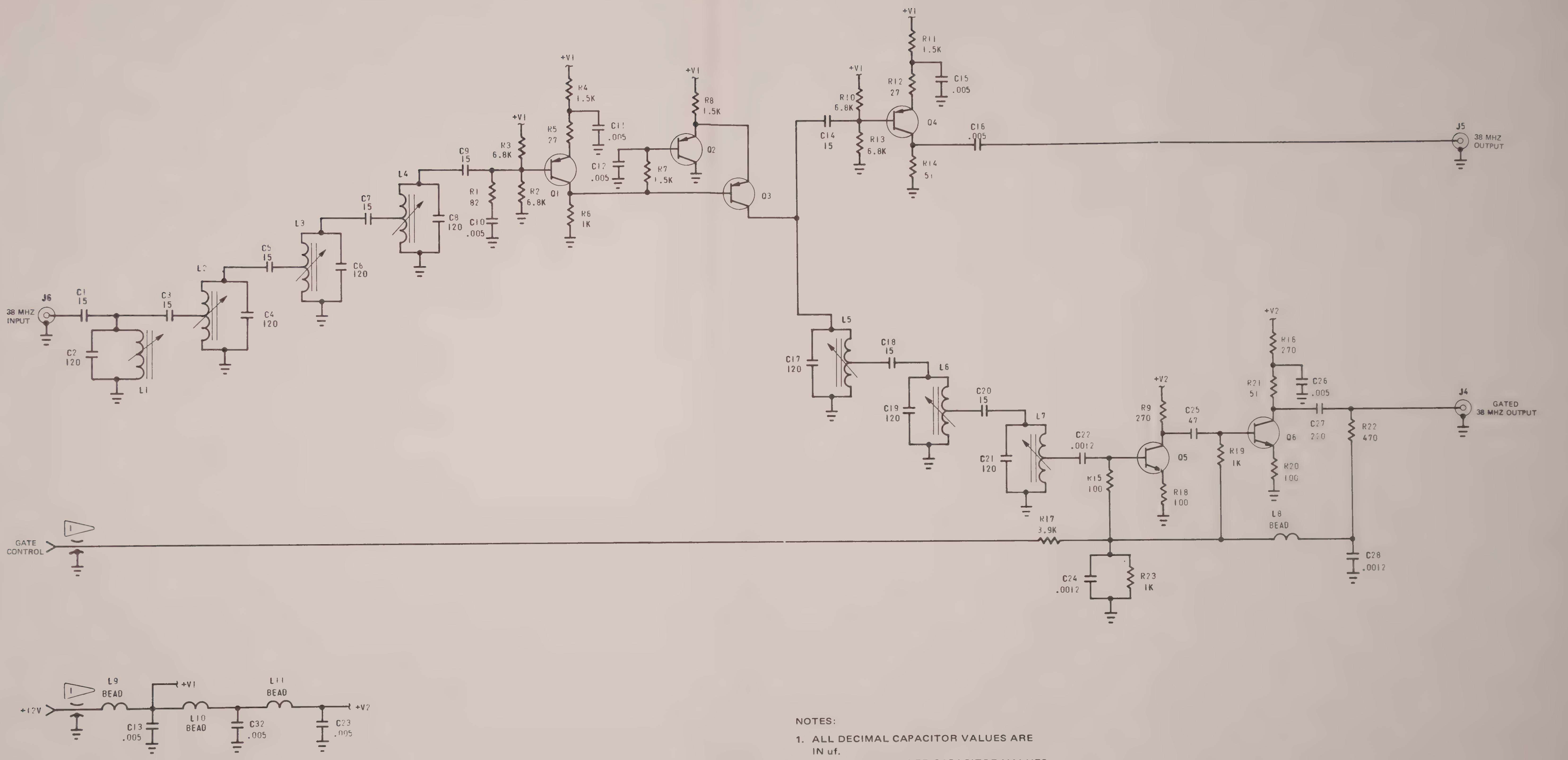
33/38 MHz FILTER MODULE

Drawing No. 645-1129-4 (1 of 2)

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

41


J6
38 MHZ INPUT
C1 15
C2 120
L1
C3 15
L2
C4 120
C5 15
L3
C6 120
C7 15
L4
C8 120
C9 15
R1 82
C10 .005
R3 6.8K
R2 6.8K
+V1
R5 27
Q1
R4 1.5K
C11 .005
R6 1K
C12 .005
R7 1.5K
R8 1.5K
Q2
Q3
C14 15
R10 6.8K
R13 6.8K
R11 1.5K
R12 27
C15 .005
Q4
R14 51
C16 .005
J5
38 MHZ OUTPUT
L5
C17 120
C18 15
L6
C19 120
C20 15
L7
C21 120
C22 .0012
R15 100
+V2
R9 270
Q5
R18 100
C25 47
R19 1K
R16 270
C26 .005
R21 51
Q6
R20 100
C27 270
R22 470
J4
GATED 38 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C28 .0012
C24 .0012
R23 1K
+12V
L9 BEAD
+V1
C13 .005
L10 BEAD
C32 .005
L11 BEAD
C23 .005
+V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

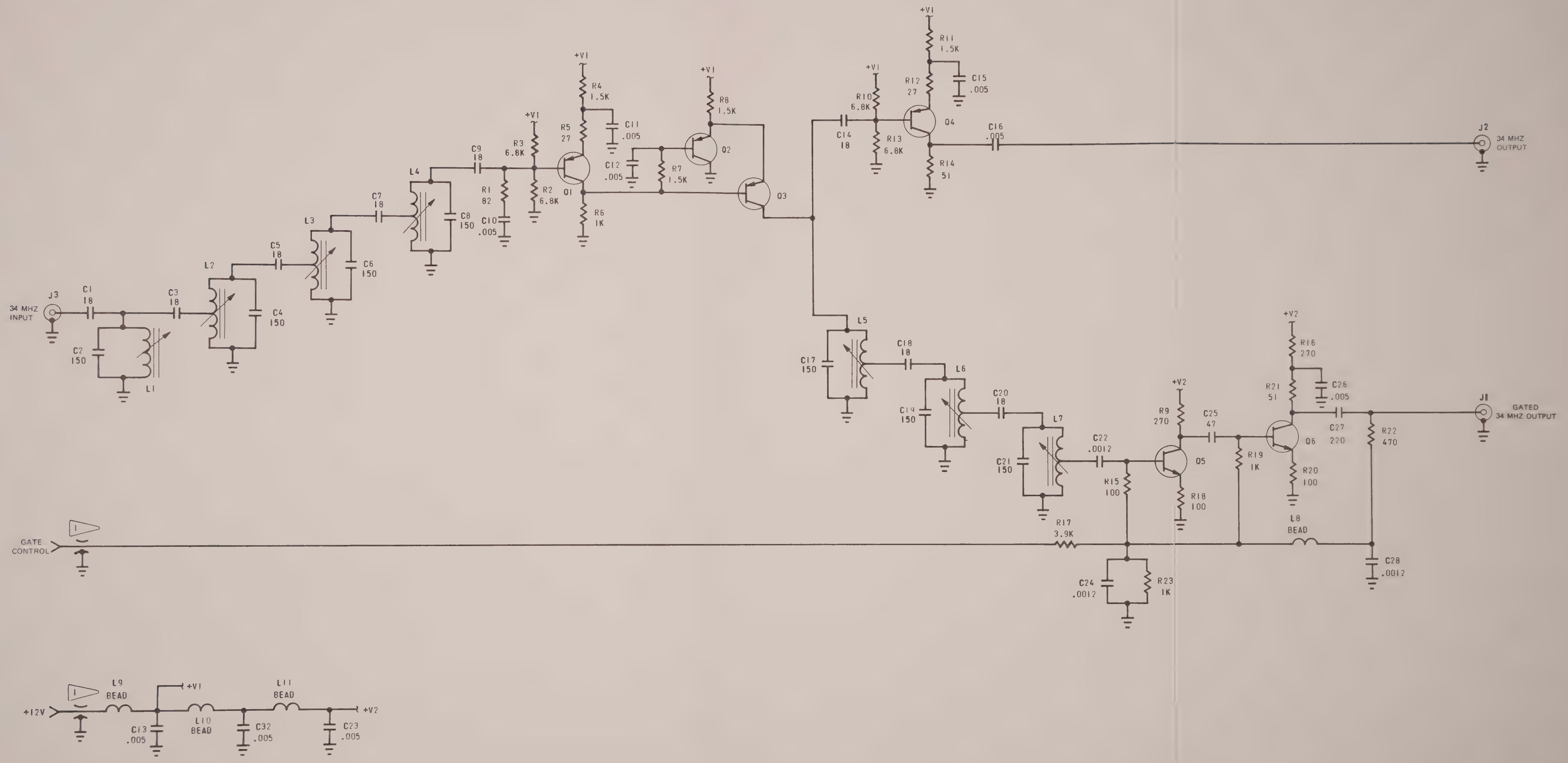
FUNCTIONAL SCHEMATIC DIAGRAM

33/38 MHz FILTER MODULE

Drawing No. 645-1129-4 (2 of 2)

REV
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


34 MHZ INPUT
J3
C1 18
C2 150
L1
C3 18
L2
C4 150
C5 18
L3
C6 150
C7 18
L4
C8 150
C9 18
R1 82
C10 .005
R3 6.8K
R2 6.8K
+V1
R5 27
R4 1.5K
C11 .005
Q1
R6 1K
C12 .005
R7 1.5K
R8 1.5K
Q2
Q3
C14 18
R10 6.8K
R13 6.8K
R12 27
R11 1.5K
C15 .005
Q4
R14 51
C16 .005
J2
34 MHZ OUTPUT
L5
C17 150
C18 18
L6
C19 150
C20 18
L7
C21 150
C22 .0012
R15 100
Q5
R9 270
R18 100
+V2
C25 47
R19 1K
Q6
R16 270
R21 51
C26 .005
R20 100
C27 220
R22 470
J1
GATED 34 MHZ OUTPUT
GATE CONTROL
1
R17 3.9K
L8 BEAD
C28 .0012
C24 .0012
R23 1K
+12V
L9 BEAD
C13 .005
L10 BEAD
C32 .005
L11 BEAD
C23 .005

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

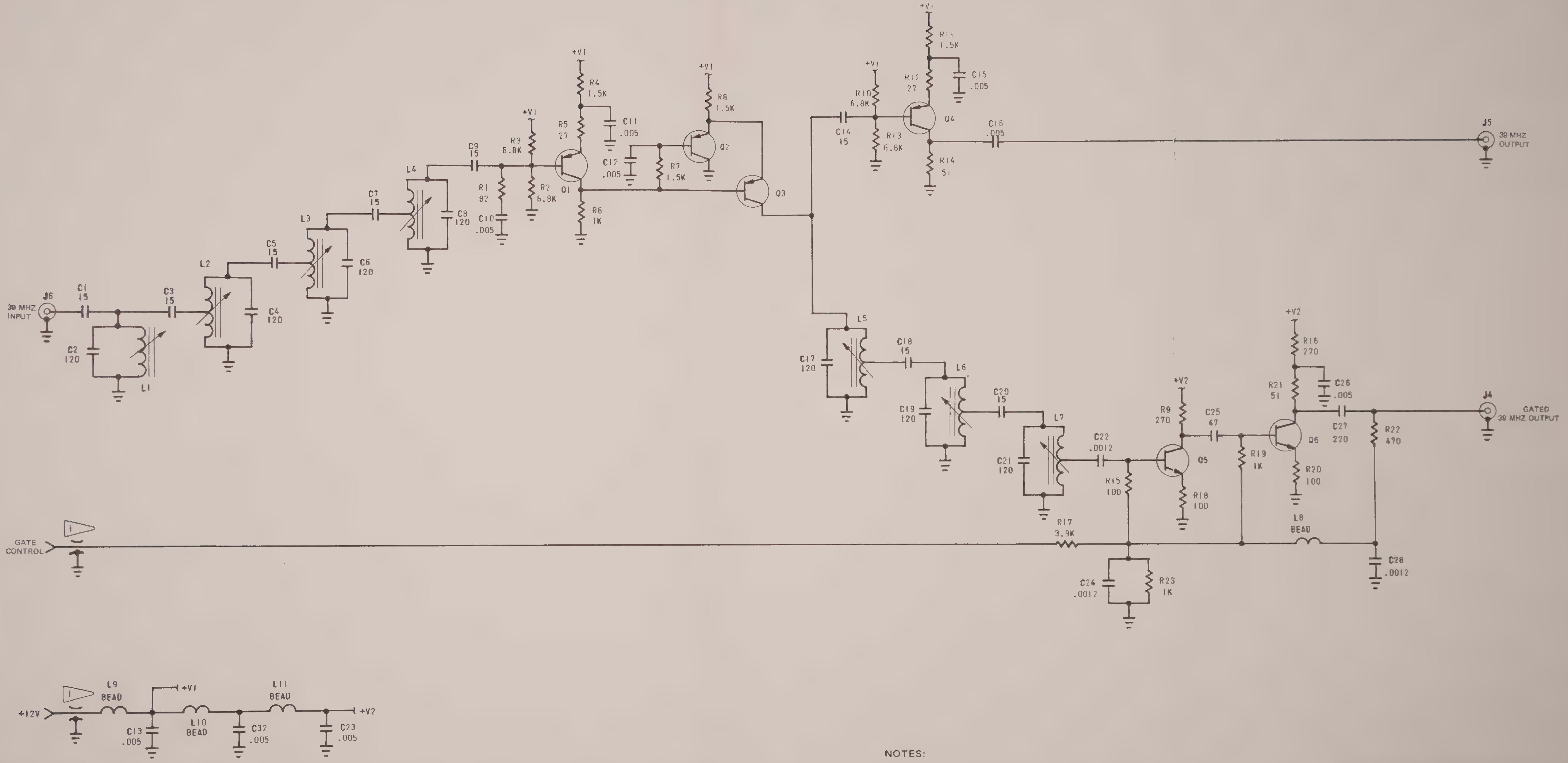
FUNCTIONAL SCHEMATIC DIAGRAM

34/39 MHz FILTER MODULE

Drawing No. 645-1129-5 (1 of 2)

REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


39 MHZ INPUT
J6
C1 15
C2 120
L1
C3 15
L2
C4 120
C5 15
L3
C6 120
C7 15
L4
C8 120
C9 15
R1 82
C10 .005
R3 6.8K
R2 6.8K
+V1
R4 1.5K
R5 27
Q1
R6 1K
C11 .005
C12 .005
R7 1.5K
R8 1.5K
Q2
Q3
C14 15
R10 6.8K
R13 6.8K
R11 1.5K
R12 27
C15 .005
Q4
R14 51
C16 .005
J5
39 MHZ OUTPUT
L5
C17 120
C18 15
L6
C19 120
C20 15
L7
C21 120
C22 .0012
R15 100
R17 3.9K
C24 .0012
R23 1K
+V2
R9 270
Q5
R18 100
C25 47
R19 1K
R16 270
R21 51
C26 .005
Q6
R20 100
C27 220
R22 470
L8 BEAD
C28 .0012
J4
GATED 39 MHZ OUTPUT
GATE CONTROL
1
+12V
L9 BEAD
C13 .005
L10 BEAD
C32 .005
L11 BEAD
C23 .005
+V1
+V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

34/39 MHz FILTER MODULE

Drawing No. 645-1129-5 (2 of 2)

REV b

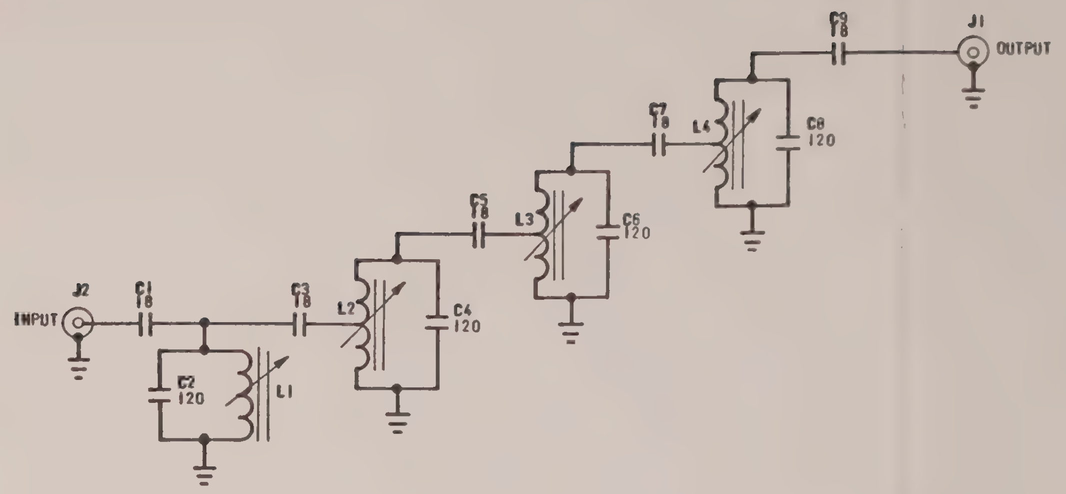
FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

NOTES:

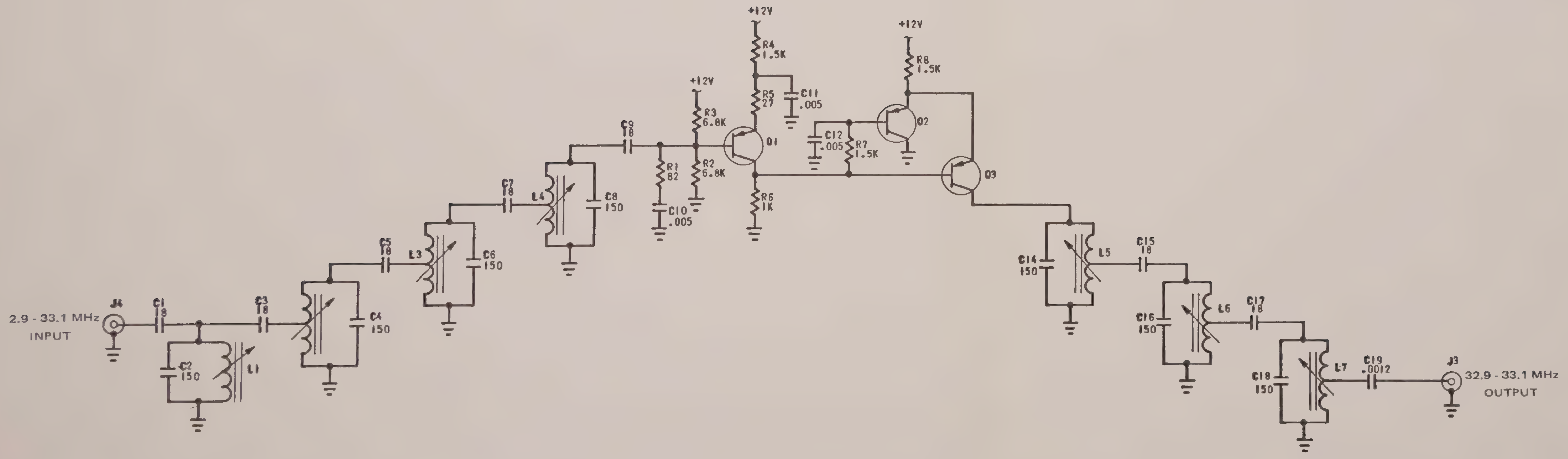
1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

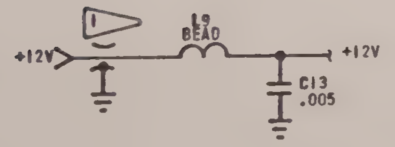
1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.


J2
INPUT
C1 18
C2 120
L1
C3 18
L2
C4 120
C5 18
L3
C6 120
C7 18
L4
C8 120
C9 18
J1
OUTPUT

DAM FILTER #1


2.9 - 33.1 MHz INPUT
J4
C1 18
C2 150
L1
C3 18
C4 150
C5 18
L3
C6 150
C7 18
L4
C8 150
C9 18
R1 82
C10 .005
+12V
R3 6.8K
R2 6.8K
+12V
R4 1.5K
R5 27
C11 .005
Q1
R6 1K
C12 .005
R7 1.5K
+12V
R8 1.5K
Q2
Q3
C14 150
L5
C15 18
C16 150
L6
C17 18
C18 150
L7
C19 .0012
J3
32.9 - 33.1 MHz OUTPUT


1
+12V
L9 BEAD
+12V
C13 .005

SCH/OSC FILTER

FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT ADDER FILTER/SEARCH OSCILLATOR MODULE

Drawing No. 645-1129-6

REV a

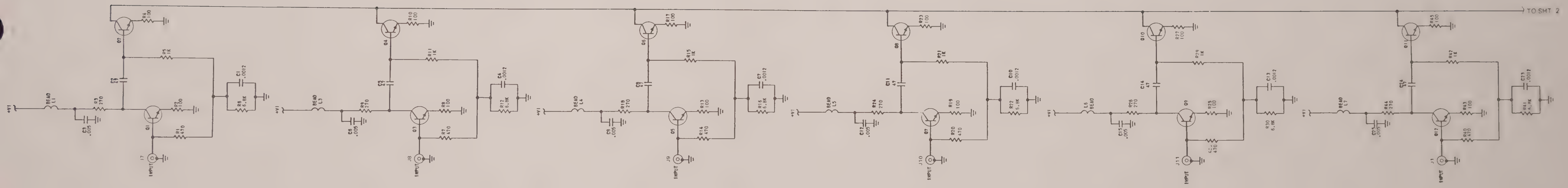
FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

NOTES

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf
3. ALL RESISTOR VALUES ARE IN OHMS
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED THRU CAPACITOR MOUNTED ON METAL ENCLOSURE

*FACTORY SELECTED VALUE


+V1
BEAD L1
C3 .005
R3 270
C2 47
Q2
R4 100
R5 1K
Q1
R2 100
R1 470
J7
INPUT
C1 .0012
R6 6.8K
+V1
BEAD L3
C6 .005
R9 270
C5 47
Q4
R10 100
R11 1K
Q3
R8 100
R7 470
J8
INPUT
C4 .0012
R12 6.8K
+V1
BEAD L4
C9 .005
R18 270
C8 47
Q6
R17 100
R15 1K
Q5
R13 100
R14 470
J9
INPUT
C7 .0012
R16 6.8K
+V1
BEAD L5
C12 .005
R24 270
C11 47
Q8
R23 100
R21 1K
Q7
R19 100
R20 470
J10
INPUT
C10 .0012
R22 6.8K
+V1
L6 BEAD
C15 .005
R26 270
C14 47
Q10
R27 100
R29 1K
Q9
R25 100
470
J11
INPUT
C13 .0012
R30 6.8K
+V1
BEAD L7
C25 .005
R44 270
C24 47
Q11
R45 100
R42 1K
Q12
R43 100
R40 470
J1
INPUT
C23 .0012
R41 6.8K
TO SHT 2

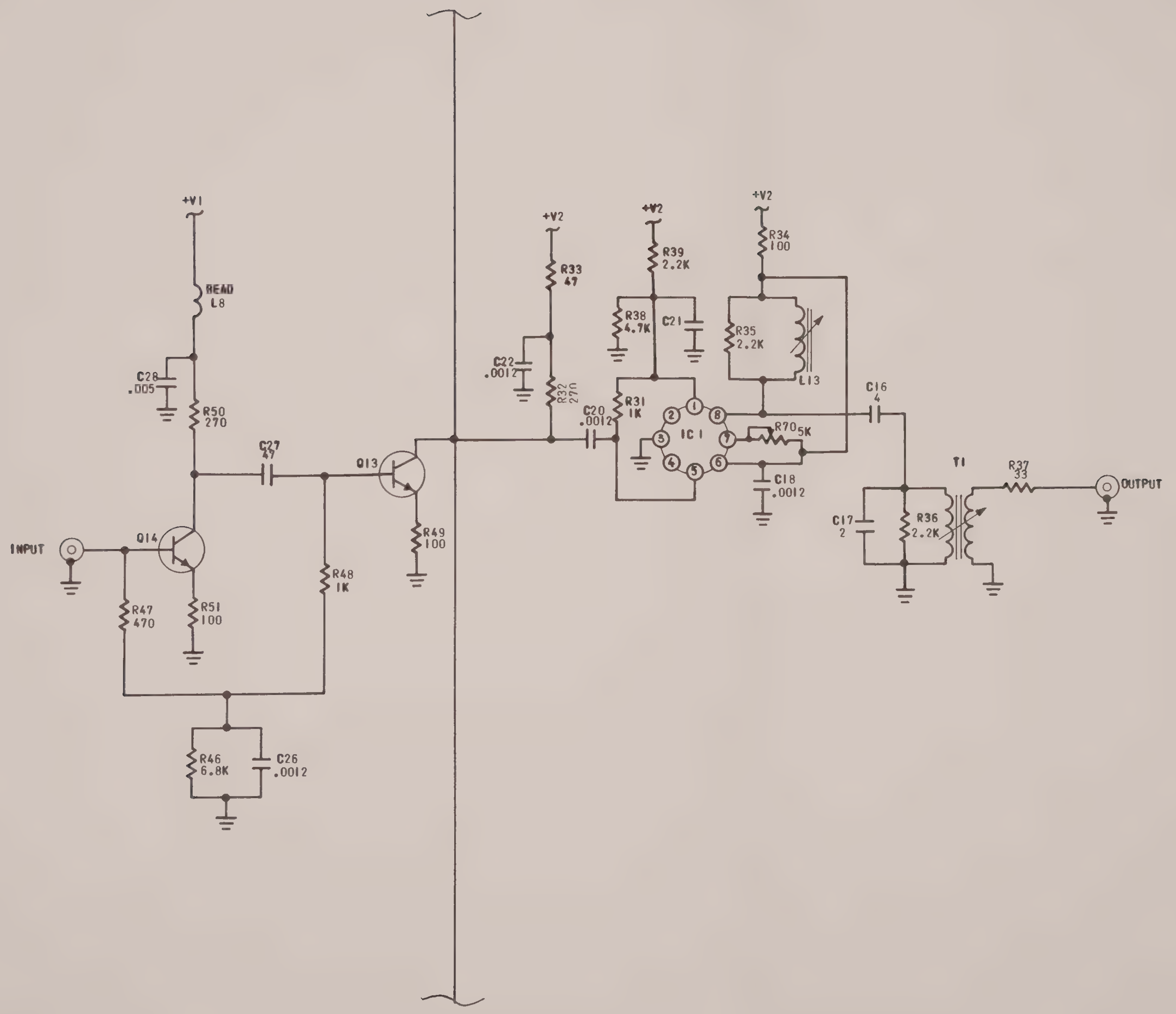
FUNCTIONAL SCHEMATIC DIAGRAM

30-39 MHz GATE MODULE

Drawing No. 645-1133 Sheet 1

REV
a

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
BEAD
L8
C28
.005
R50
270
C27
47
Q13
INPUT
Q14
R47
470
R51
100
R48
1K
R49
100
R46
6.8K
C26
.0012
+V2
R33
47
C22
.0012
R32
270
C20
.0012
+V2
R39
2.2K
R38
4.7K
C21
R31
1K
IC1
1
2
3
4
5
6
7
8
R70
5K
C18
.0012
+V2
R34
100
R35
2.2K
L13
C16
4
T1
R37
33
OUTPUT
C17
2
R36
2.2K

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

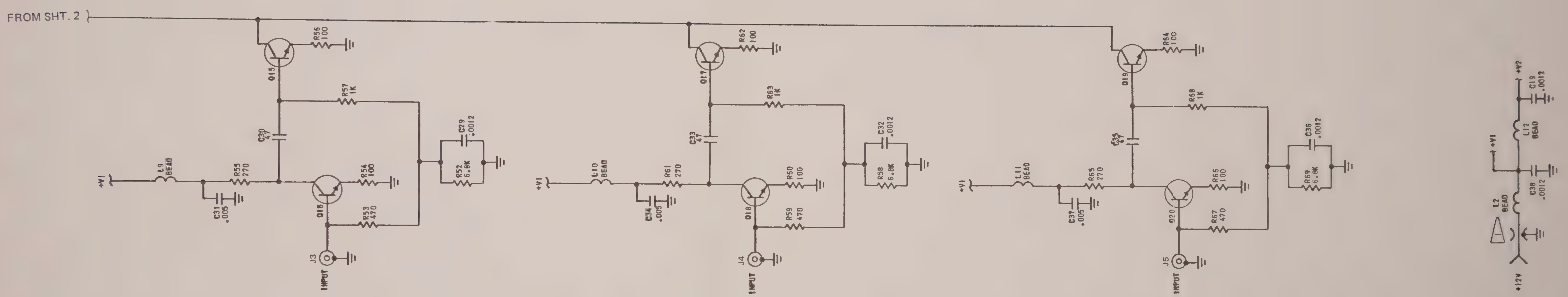
FUNCTIONAL SCHEMATIC DIAGRAM

30-39 MHz GATE MODULE

Drawing No. 645-1133 Sheet 2

REV.
b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


FROM SHT. 2
Q15
R56 100
R57 1K
C30 47
C29 .0012
R52 6.8K
+V1
L9 BEAD
R55 270
C31 .005
Q16
R54 100
R53 470
J3
INPUT
Q17
R62 100
R63 1K
C33 47
C32 .0012
R58 6.8K
+V1
L10 BEAD
R61 270
C34 .005
Q18
R60 100
R59 470
J4
INPUT
Q19
R64 100
R68 1K
C35 47
C36 .0012
R69 6.8K
+V1
L11 BEAD
R65 270
C37 .005
Q20
R66 100
R67 470
J5
INPUT
+V2
C19 .0012
L12 BEAD
+V1
C38 .0012
L2 BEAD
+12V

FUNCTIONAL SCHEMATIC DIAGRAM

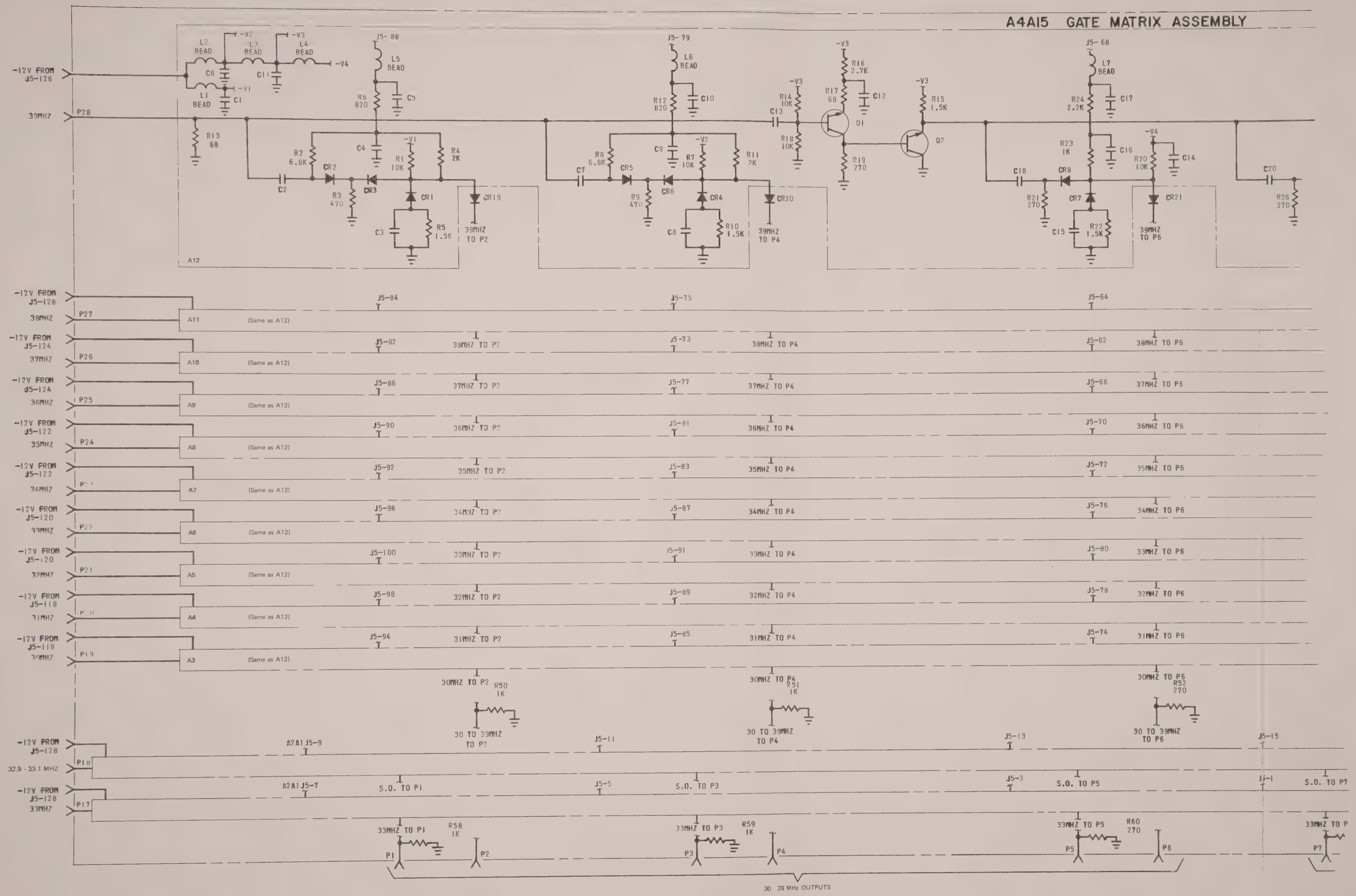
30-39 MHz GATE MODULE

Drawing No. 645-1133 Sheet 3

REV
a

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

48


A4A15 GATE MATRIX ASSEMBLY
-12V FROM J5-126
39MHZ
P28
L1 BEAD
L2 BEAD
L3 BEAD
L4 BEAD
-V1
-V2
-V3
-V4
C6
C1
C11
R13 68
J5-88
L5 BEAD
R6 820
C5
C2
R2 6.8K
CR2
R3 470
CR3
C4
R1 10K
CR1
R4 2K
CR19
C3
R5 1.5K
39MHZ TO P2
A12
J5-79
L6 BEAD
R12 820
C10
C7
R8 6.8K
CR5
R9 470
CR6
C9
R7 10K
CR4
R11 2K
CR20
C8
R10 1.5K
39MHZ TO P4
C13
R14 10K
R18 10K
R16 2.7K
R17 68
C12
Q1
R19 270
R15 1.5K
Q2
J5-68
L7 BEAD
R24 2.2K
C17
R23 1K
C16
C18
CR8
R21 270
CR7
C15
R22 1.5K
R20 10K
C14
CR21
39MHZ TO P6
C20
R26 270
-12V FROM J5-126
38MHZ
P27
A11
(Same as A12)
J5-84
J5-75
J5-64
-12V FROM J5-124
37MHZ
P26
A10
(Same as A12)
J5-82
38MHZ TO P2
J5-73
38MHZ TO P4
J5-62
38MHZ TO P6
-12V FROM J5-124
36MHZ
P25
A9
(Same as A12)
J5-86
37MHZ TO P2
J5-77
37MHZ TO P4
J5-66
37MHZ TO P6
-12V FROM J5-122
35MHZ
P24
A8
(Same as A12)
J5-90
36MHZ TO P2
J5-81
36MHZ TO P4
J5-70
36MHZ TO P6
-12V FROM J5-122
34MHZ
A7
(Same as A12)
J5-92
35MHZ TO P2
J5-83
35MHZ TO P4
J5-72
35MHZ TO P6
-12V FROM J5-120
33MHZ
P22
A6
(Same as A12)
J5-96
34MHZ TO P2
J5-87
34MHZ TO P4
J5-76
34MHZ TO P6
-12V FROM J5-120
32MHZ
P21
A5
(Same as A12)
J5-100
33MHZ TO P2
J5-91
33MHZ TO P4
J5-80
33MHZ TO P6
-12V FROM J5-118
31MHZ
A4
(Same as A12)
J5-98
32MHZ TO P2
J5-89
32MHZ TO P4
J5-78
32MHZ TO P6
-12V FROM J5-118
30MHZ
P19
A3
(Same as A12)
J5-94
31MHZ TO P2
J5-85
31MHZ TO P4
J5-74
31MHZ TO P6
30MHZ TO P2
R50 1K
30 TO 39MHZ TO P2
30MHZ TO P4
R51 1K
30 TO 39MHZ TO P4
30MHZ TO P6
R52 270
30 TO 39MHZ TO P6
-12V FROM J5-128
32.9 - 33.1 MHZ
P18
A2A1 J5-9
J5-11
J5-13
J5-15
-12V FROM J5-128
33MHZ
P17
A2A1 J5-7
S.O. TO P1
J5-5
S.O. TO P3
J5-3
S.O. TO P5
J5-1
S.O. TO P7
33MHZ TO P1
R58 1K
P1
P2
33MHZ TO P3
R59 1K
P3
P4
33MHZ TO P5
R60 270
P5
P6
33MHZ TO P
P7
30 39 MHz OUTPUTS

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

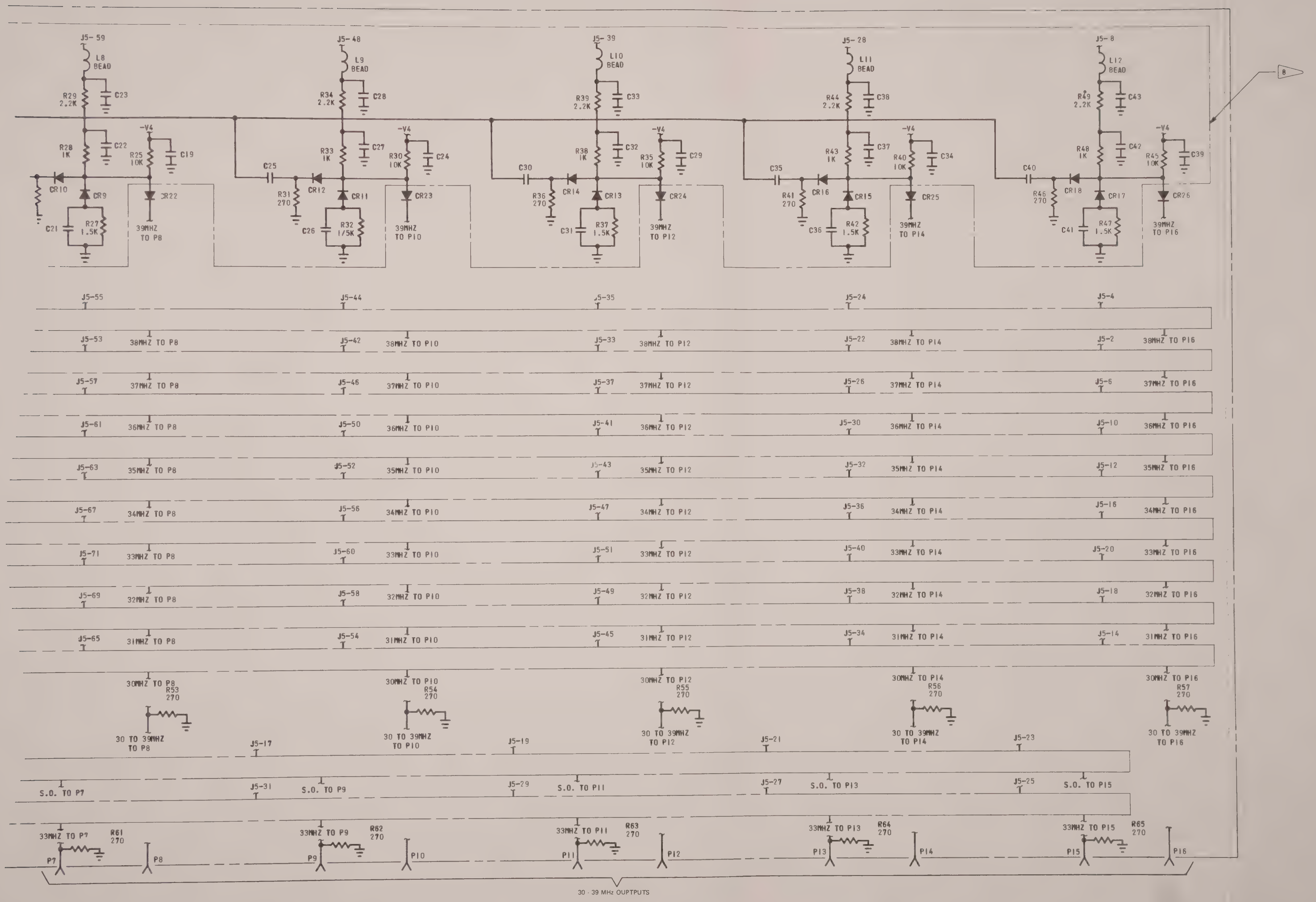
FUNCTIONAL SCHEMATIC DIAGRAM

GATE MATRIX MODULE

Drawing No. 645-1134 Sheet 1

REV. b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133



J5-59
L8 BEAD
R29 2.2K
C23
R28 1K
C22
-V4
R25 10K
C19
CR10
CR9
CR22
C21
R27 1.5K
39MHZ TO P8
J5-48
L9 BEAD
R34 2.2K
C28
R33 1K
C27
-V4
R30 10K
C24
C25
CR12
CR11
CR23
R31 270
C26
R32 1.5K
39MHZ TO P10
J5-39
L10 BEAD
R39 2.2K
C33
R38 1K
C32
-V4
R35 10K
C29
C30
CR14
CR13
CR24
R36 270
C31
R37 1.5K
39MHZ TO P12
J5-28
L11 BEAD
R44 2.2K
C38
R43 1K
C37
-V4
R40 10K
C34
C35
CR16
CR15
CR25
R41 270
C36
R42 1.5K
39MHZ TO P14
J5-8
L12 BEAD
R49 2.2K
C43
R48 1K
C42
-V4
R45 10K
C39
C40
CR18
CR17
CR26
R46 270
C41
R47 1.5K
39MHZ TO P16
8
J5-55
J5-44
J5-35
J5-24
J5-4
J5-53
38MHZ TO P8
J5-42
38MHZ TO P10
J5-33
38MHZ TO P12
J5-22
38MHZ TO P14
J5-2
38MHZ TO P16
J5-57
37MHZ TO P8
J5-46
37MHZ TO P10
J5-37
37MHZ TO P12
J5-26
37MHZ TO P14
J5-6
37MHZ TO P16
J5-61
36MHZ TO P8
J5-50
36MHZ TO P10
J5-41
36MHZ TO P12
J5-30
36MHZ TO P14
J5-10
36MHZ TO P16
J5-63
35MHZ TO P8
J5-52
35MHZ TO P10
J5-43
35MHZ TO P12
J5-32
35MHZ TO P14
J5-12
35MHZ TO P16
J5-67
34MHZ TO P8
J5-56
34MHZ TO P10
J5-47
34MHZ TO P12
J5-36
34MHZ TO P14
J5-16
34MHZ TO P16
J5-71
33MHZ TO P8
J5-60
33MHZ TO P10
J5-51
33MHZ TO P12
J5-40
33MHZ TO P14
J5-20
33MHZ TO P16
J5-69
32MHZ TO P8
J5-58
32MHZ TO P10
J5-49
32MHZ TO P12
J5-38
32MHZ TO P14
J5-18
32MHZ TO P16
J5-65
31MHZ TO P8
J5-54
31MHZ TO P10
J5-45
31MHZ TO P12
J5-34
31MHZ TO P14
J5-14
31MHZ TO P16
30MHZ TO P8
R53 270
30 TO 39MHZ TO P8
30MHZ TO P10
R54 270
30 TO 39MHZ TO P10
30MHZ TO P12
R55 270
30 TO 39MHZ TO P12
30MHZ TO P14
R56 270
30 TO 39MHZ TO P14
30MHZ TO P16
R57 270
30 TO 39MHZ TO P16
J5-17
J5-19
J5-21
J5-23
S.O. TO P7
J5-31
S.O. TO P9
J5-29
S.O. TO P11
J5-27
S.O. TO P13
J5-25
S.O. TO P15
33MHZ TO P7
R61 270
P7
P8
33MHZ TO P9
R62 270
P9
P10
33MHZ TO P11
R63 270
P11
P12
33MHZ TO P13
R64 270
P13
P14
33MHZ TO P15
R65 270
P15
P16
30 - 39 MHz OUTPUTS

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

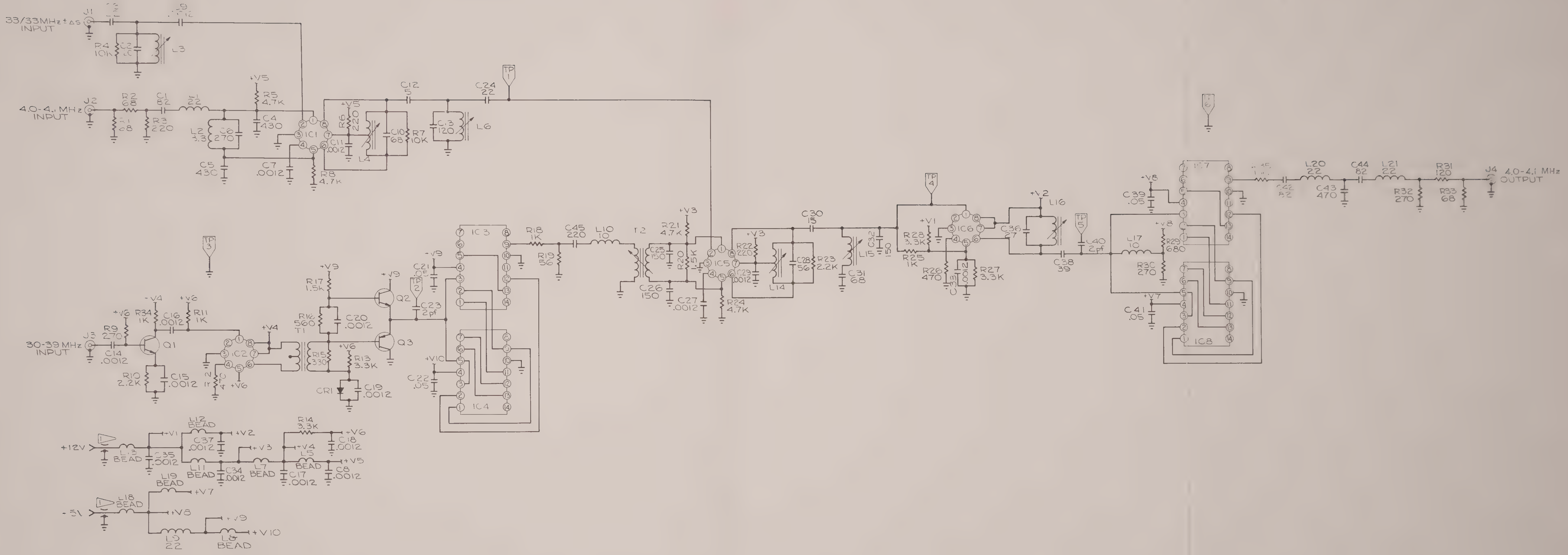
FUNCTIONAL SCHEMATIC DIAGRAM

GATE MATRIX MODULE

Drawing No. 645-1134 Sheet 2

REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


33/33MHz ±.05 INPUT
J1
R4 10K
L3
4.0-4.1 MHz INPUT
J2
R2 68
R1 68
R3 220
C1 82
L1 22
L2 3.3
C6 270
C5 430
R5 4.7K
C4 430
+V5
IC1
C7 .0012
R8 4.7K
R6 220
C11 .0012
L4
C12 5
C10 68
R7 10K
C24 22
TP 1
C13 120
L6
TP 3
30-39 MHz INPUT
J3
R9 270
C14 .0012
Q1
R10 2.2K
C15 .0012
R34 1K
C16 .0012
R11 1K
IC2
T1
R16 560
R15 330
R13 3.3K
CR1
C19 .0012
R17 1.5K
C20 .0012
Q2
Q3
TP 2
C23 2pf
C21 .05
C22 .05
IC3
IC4
R18 1K
R19 56
C45 220
L10 10
T2
C25 150
C26 150
C27 .0012
R21 4.7K
R20 1.5K
IC5
R22 220
C29 .0012
R24 4.7K
C28 56
R23 2.2K
L14
C30 15
L15
C32 150
C31 68
TP 4
R28 3.3K
R25 1K
IC6
R26 470
R27 3.3K
C36 27
L16
TP 5
C40 2pf
C38 39
TP 6
C39 .05
L17 10
R29 680
R30 270
C41 .05
IC7
IC8
C42 82
L20 22
C43 470
C44 82
L21 22
R31 120
R32 270
R33 68
J4
4.0-4.1 MHz OUTPUT
+12V
L13 BEAD
C35 .0012
L12 BEAD
C37 .0012
L11 BEAD
C34 .0012
L7 BEAD
R14 3.3K
C18 .0012
L5 BEAD
C17 .0012
C8 .0012
-51
L18 BEAD
L19 BEAD
L9 22
L8 BEAD
+V1
+V2
+V3
+V4
+V5
+V6
+V7
+V8
+V9
+V10

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

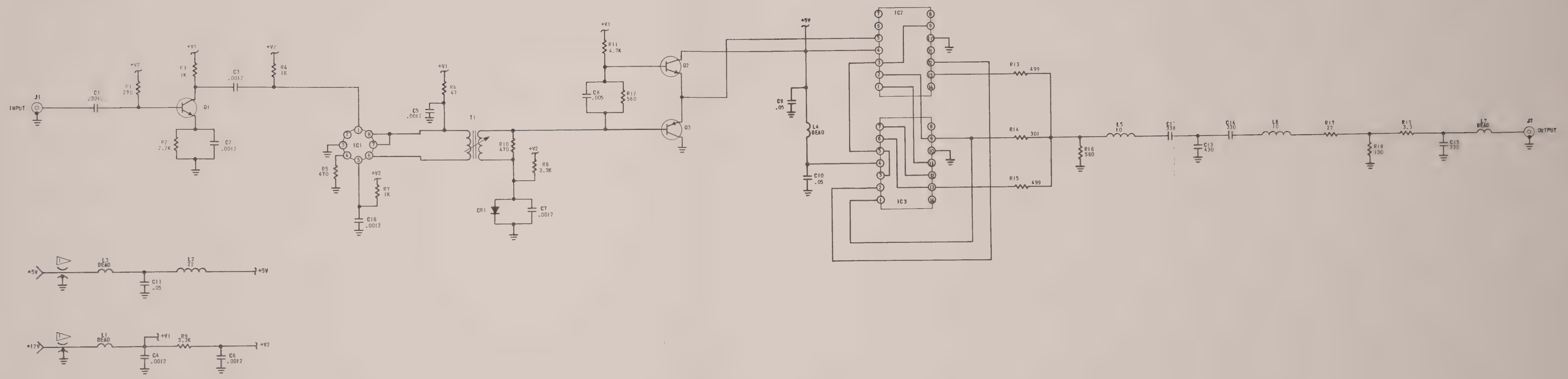
FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT SHIFT MIXER MODULE

Drawing No. 645-1135

REV. b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


INPUT
J1
C1
.001
+V2
R1
270
+V1
R3
1K
Q1
R2
2.2K
C2
.0012
C3
.0012
+V2
R4
1K
IC1
1
2
3
4
5
6
7
8
R5
470
+V2
R7
1K
C16
.0012
C5
.0012
+V1
R6
47
T1
R10
470
+V2
R8
3.3K
CR1
C7
.0012
+V1
R11
4.7K
C8
.005
R12
560
Q2
Q3
+5V
C9
.05
L4
BEAD
C10
.05
IC2
IC3
R13
499
R14
301
R15
499
R16
560
L5
10
C1
330
C13
430
C14
330
L6
10
R17
22
R18
100
R19
3.3
C15
330
L7
BEAD
J2
OUTPUT
+5V
1
L3
BEAD
C11
.05
L2
22
+5V
+12V
1
L1
BEAD
+V1
C4
.0012
R9
3.3K
C6
.0012
+V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

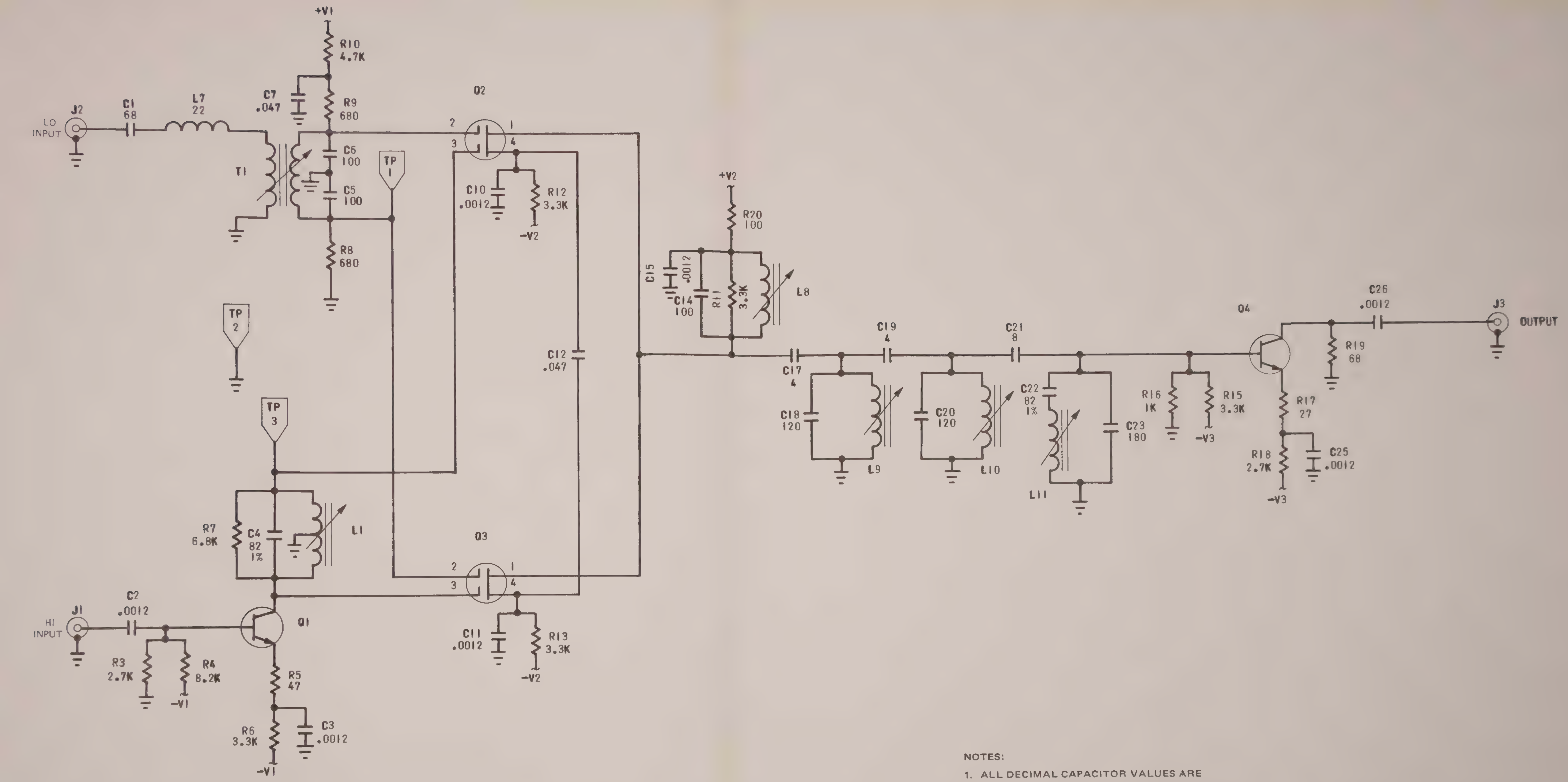
•FACTORY SELECTED VALUE

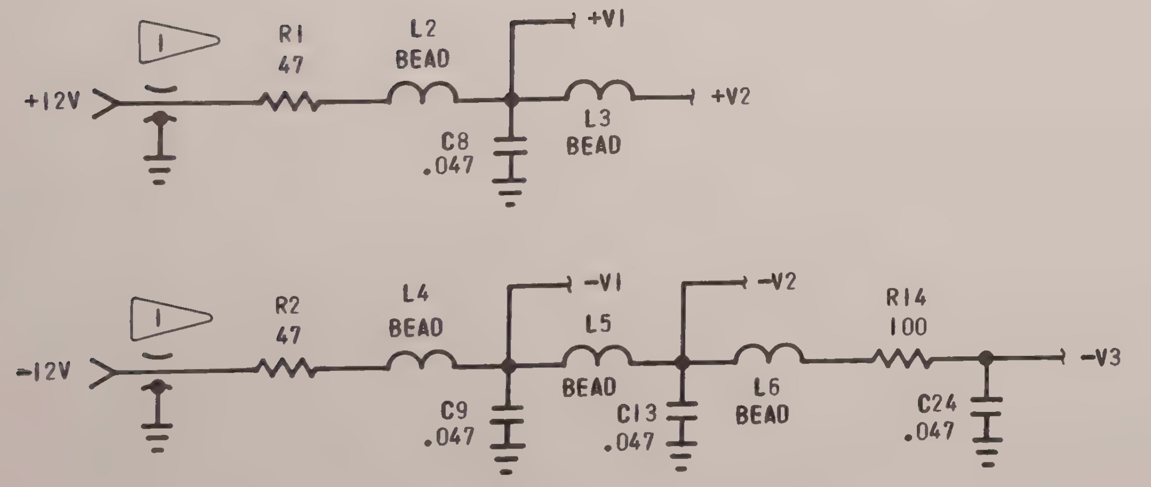
FUNCTIONAL SCHEMATIC DIAGRAM

10/1 DIVIDER NO. 1 MODULE

Drawing No. 645-1136	REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
R10 4.7K
C7 .047
R9 680
J2
LO INPUT
C1 68
L7 22
T1
C6 100
C5 100
R8 680
TP 1
TP 2
TP 3
Q2
2 3 1 4
C10 .0012
R12 3.3K
-V2
C12 .047
+V2
R20 100
C15 .0012
C14 100
R11 3.3K
L8
C17 4
C19 4
C21 8
C18 120
L9
C20 120
L10
C22 82 1%
L11
C23 180
R16 1K
R15 3.3K
-V3
Q4
R17 27
R18 2.7K
C25 .0012
-V3
R19 68
C26 .0012
J3
OUTPUT
R7 6.8K
C4 82 1%
L1
Q3
2 3 1 4
C11 .0012
R13 3.3K
-V2
J1
HI INPUT
C2 .0012
Q1
R3 2.7K
R4 8.2K
-V1
R5 47
R6 3.3K
C3 .0012
-V1


+12V
1
R1 47
L2 BEAD
+V1
+V2
L3 BEAD
C8 .047
-12V
1
R2 47
L4 BEAD
-V1
L5 BEAD
-V2
C9 .047
C13 .047
L6 BEAD
R14 100
-V3
C24 .047

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

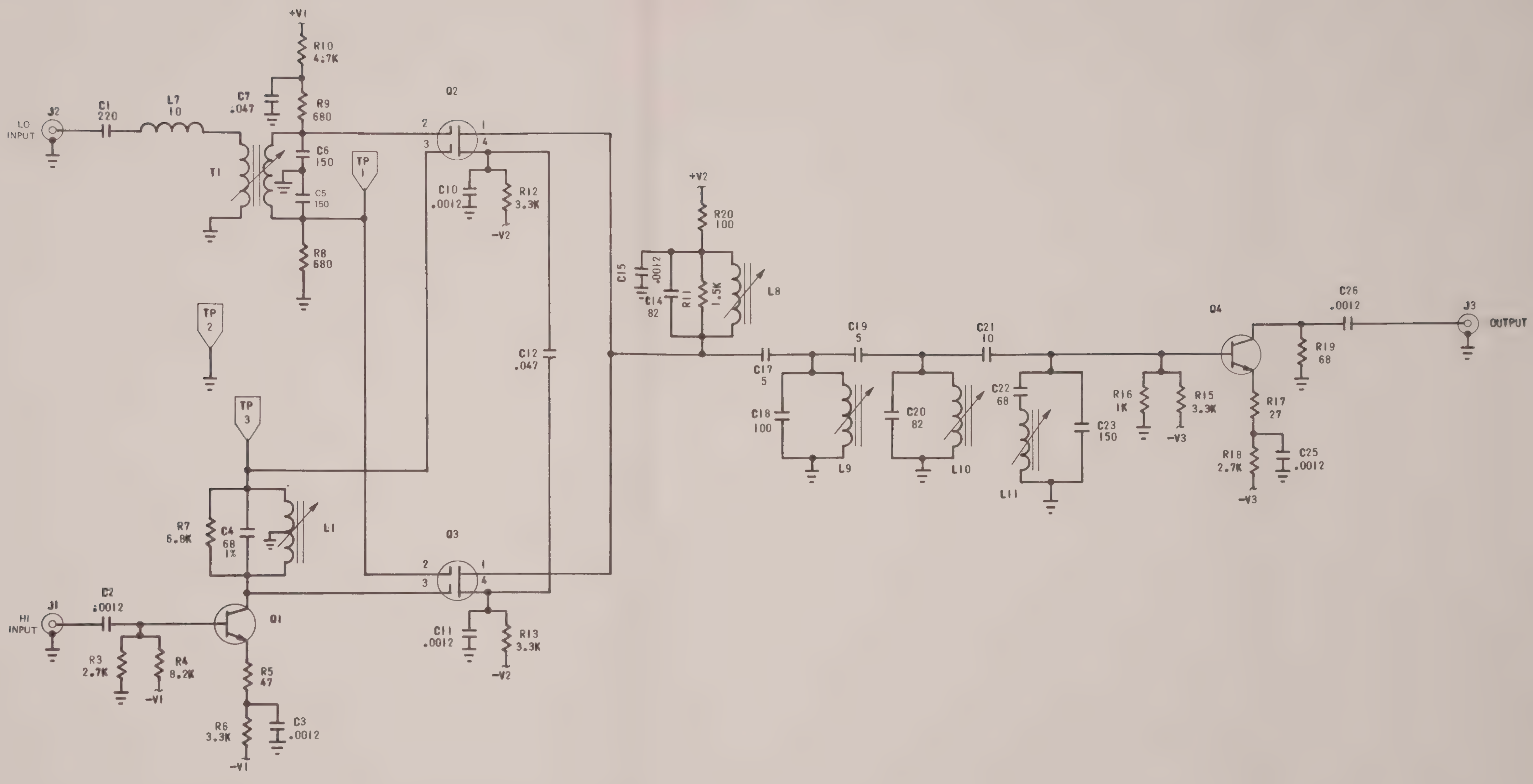
*FACTORY SELECTED VALUE

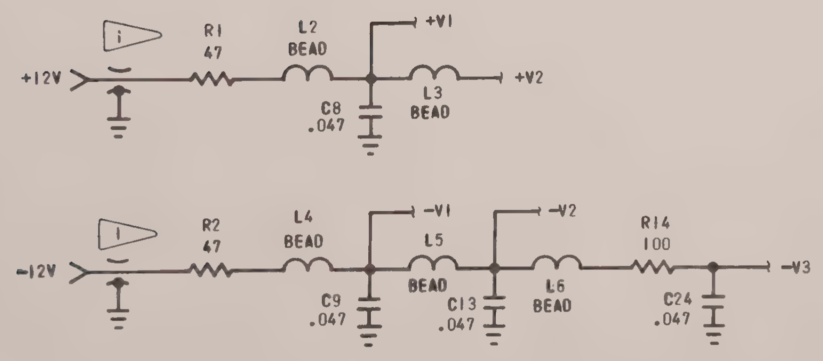
FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT SHIFT MIXER NO. 1
MODULE

Drawing No. 645-1137 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
R10 4.7K
R9 680
C7 .047
Q2
J2
LO INPUT
C1 220
L7 10
T1
C6 150
C5 150
TP 1
C10 .0012
R12 3.3K
-V2
R8 680
TP 2
TP 3
C12 .047
+V2
R20 100
C15 .0012
C14 82
R11 1.5K
L8
C19 5
C21 10
C17 5
C18 100
L9
C20 82
L10
C22 68
L11
C23 150
R16 1K
R15 3.3K
-V3
Q4
C26 .0012
J3
OUTPUT
R19 68
R17 27
R18 2.7K
C25 .0012
-V3
R7 6.8K
C4 68 1%
L1
Q3
C2 .0012
J1
HI INPUT
Q1
R3 2.7K
R4 8.2K
-V1
R5 47
R6 3.3K
C3 .0012
-V1
C11 .0012
R13 3.3K
-V2
1
2
3
4


1
+12V
R1 47
L2 BEAD
+V1
C8 .047
L3 BEAD
+V2
1
-12V
R2 47
L4 BEAD
-V1
L5 BEAD
-V2
C9 .047
C13 .047
L6 BEAD
R14 100
C24 .047
-V3

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

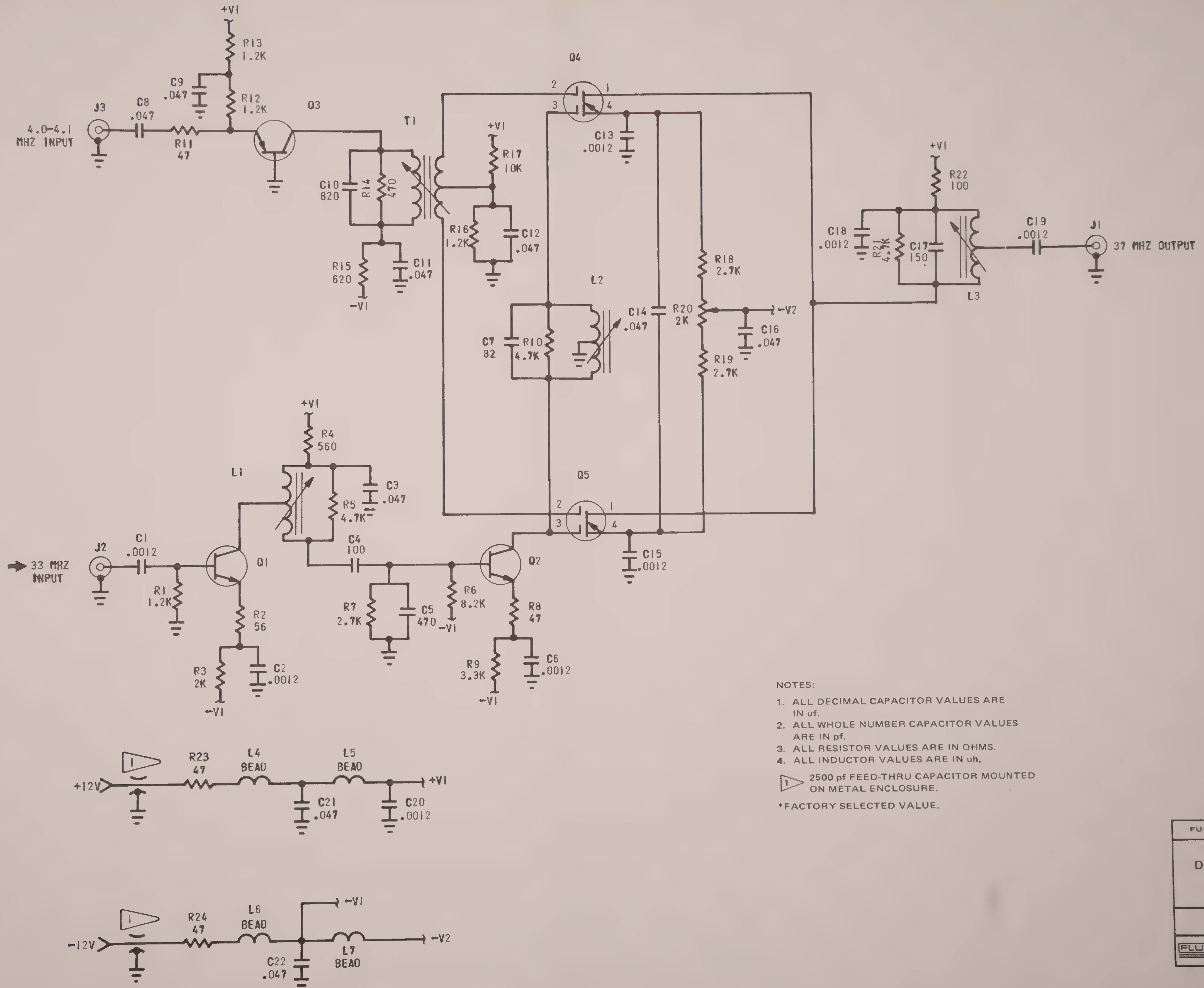
*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT SHIFT MIXER NO. 1
MODULE

Drawing No. 645-1138 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+VI
R13
1.2K
C9
.047
R12
1.2K
Q3
J3
C8
.047
4.0-4.1
MHZ INPUT
R11
47
T1
+VI
R17
10K
C10
820
R14
470
R16
1.2K
C12
.047
R15
620
C11
.047
-VI
Q4
2
1
3
4
C13
.0012
L2
C7
82
R10
4.7K
C14
.047
R18
2.7K
R20
2K
-V2
C16
.047
R19
2.7K
+VI
R22
100
C18
.0012
R21
4.7K
C17
150
L3
C19
.0012
J1
37 MHZ OUTPUT
+VI
R4
560
L1
C3
.047
R5
4.7K
Q5
2
1
3
4
C4
100
J2
C1
.0012
33 MHZ
INPUT
Q1
R1
1.2K
R2
56
R3
2K
C2
.0012
-VI
R7
2.7K
C5
470
R6
8.2K
-VI
Q2
R8
47
R9
3.3K
C6
.0012
-VI
C15
.0012
1
R23
47
L4
BEAD
L5
BEAD
+12V
+VI
C21
.047
C20
.0012
1
R24
47
L6
BEAD
-VI
-12V
-V2
L7
BEAD
C22
.047

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

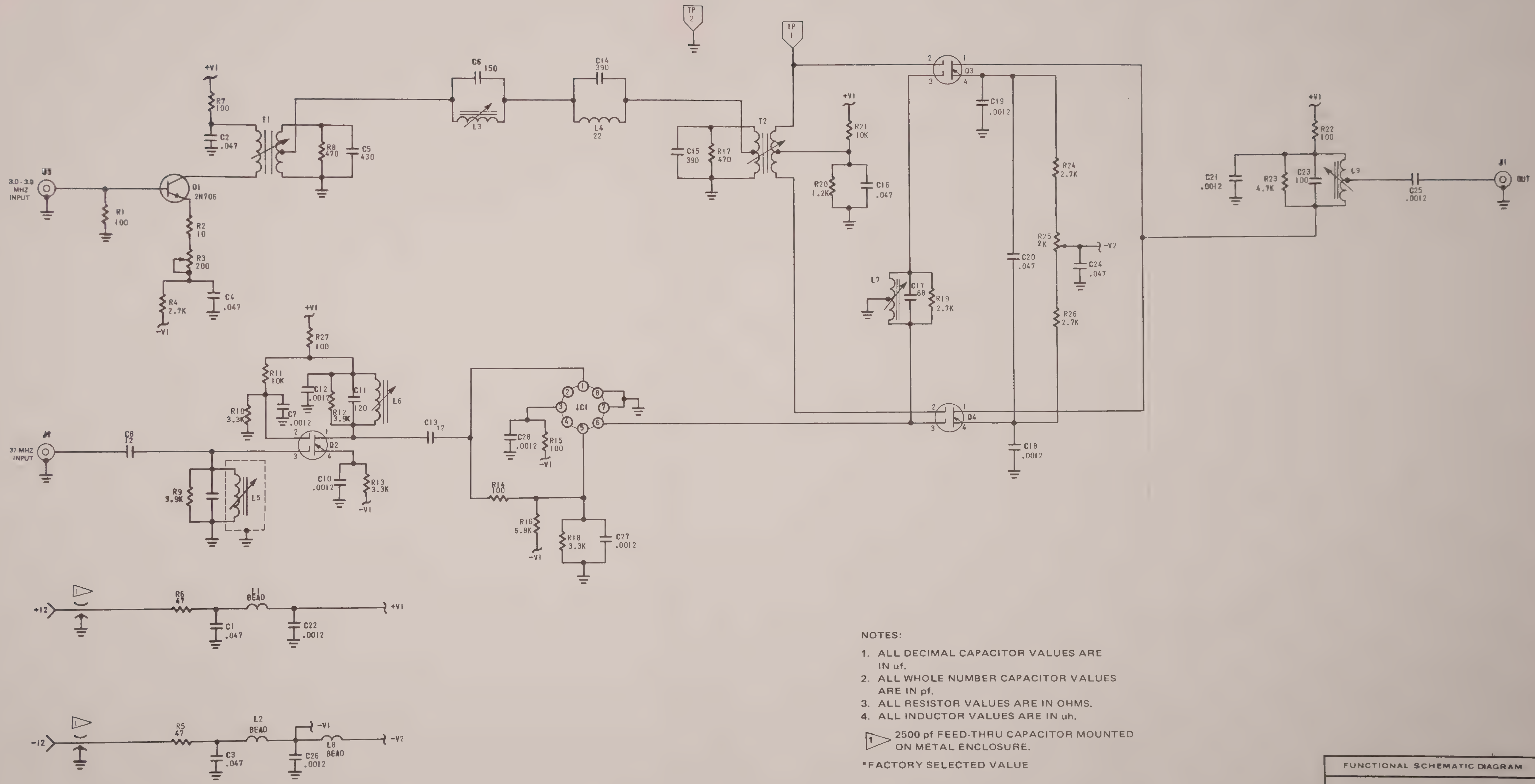
•FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT ADDER MIXER NO. 1
MODULE

Drawing No. 645-1139 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


TP 2
TP 1
C6 150
C14 390
L3
L4 22
+V1
R7 100
C2 .047
T1
R8 470
C5 430
T2
C15 390
R17 470
+V1
R21 10K
R20 1.2K
C16 .047
Q3
C19 .0012
R24 2.7K
R25 2K
-V2
C24 .047
C20 .047
R26 2.7K
L7
C17 68
R19 2.7K
Q4
C18 .0012
+V1
R22 100
C21 .0012
R23 4.7K
C23 100
L9
C25 .0012
J1 OUT
J3 3.0-3.9 MHZ INPUT
R1 100
Q1 2N706
R2 10
R3 200
R4 2.7K
-V1
C4 .047
+V1
R27 100
R11 10K
C12 .0012
R12 3.9K
C11 120
L6
R10 3.3K
C7 .0012
Q2
C13 12
IC1
C28 .0012
R15 100
-V1
J2 37 MHZ INPUT
C8 12
R9 3.9K
L5
C10 .0012
R13 3.3K
-V1
R14 100
R16 6.8K
-V1
R18 3.3K
C27 .0012
+12
R6 47
L1 BEAD
C1 .047
C22 .0012
+V1
-12
R5 47
L2 BEAD
C3 .047
-V1
C26 .0012
L8 BEAD
-V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE

FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT ADDER MIXER NO. 2
MODULE

Drawing No. 645-1141

REV
b

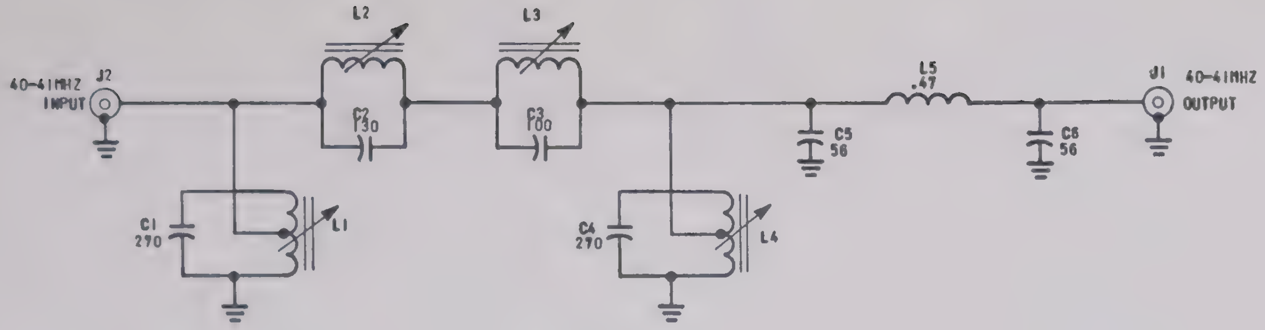
FLUKE JOHN FLUKE MFG. CO., INC.
P O Box 7428 Seattle, Washington 98133

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE



40-41MHZ INPUT
J2
C1 270
L1
L2
C2 130
L3
C3 100
C4 270
L4
C5 56
L5 .47
C6 56
J1
40-41MHZ OUTPUT

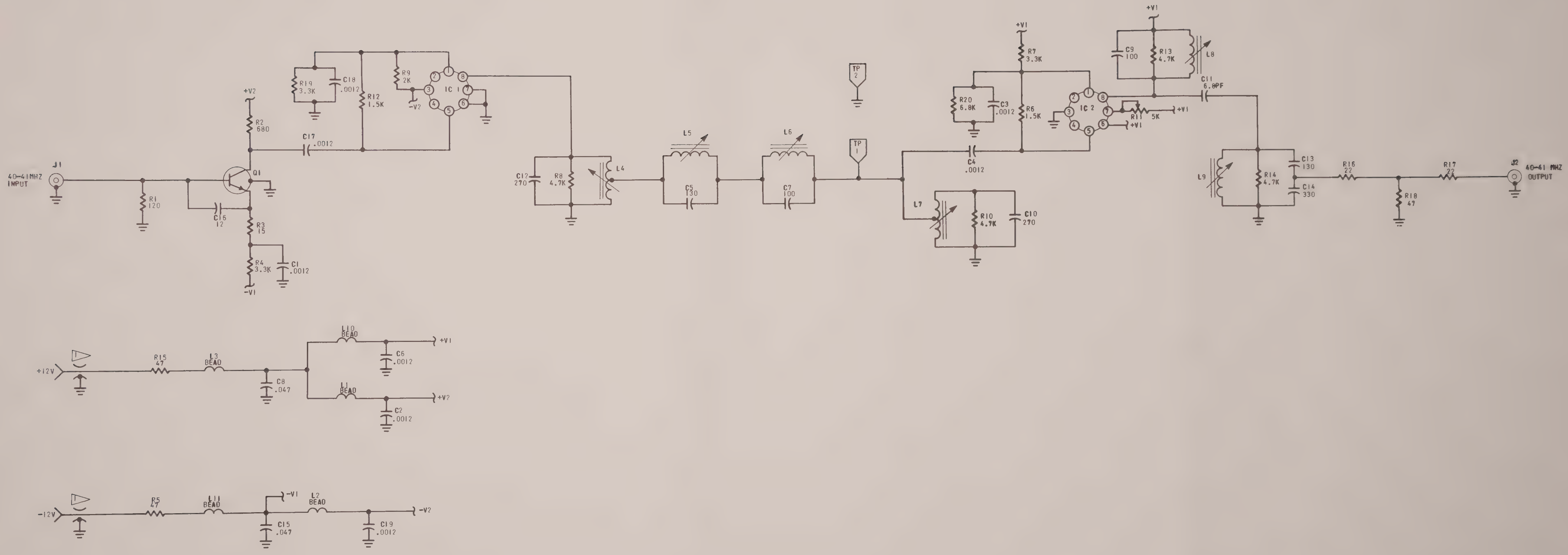
FUNCTIONAL SCHEMATIC DIAGRAM

DIGIT ADDER MIXER FILTER
NO. 2 MODULE

Drawing No. 645-1142

REV
a

FLUKE JOHN FLUKE MFG. CO., INC.
P.O Box 7428 Seattle, Washington 98133


40-41MHZ INPUT
J1
R1 120
C16 12
Q1
+V2
R2 680
R3 15
R4 3.3K
C1 .0012
-V1
C17 .0012
R19 3.3K
C18 .0012
R12 1.5K
R9 2K
-V2
IC 1
1
2
3
4
5
6
7
8
C12 270
R8 4.7K
L4
L5
C5 130
L6
C7 100
TP 2
TP 1
+V1
R7 3.3K
R20 6.8K
C3 .0012
R6 1.5K
C4 .0012
IC 2
R11 5K
+V1
C9 100
R13 4.7K
L8
C11 6.8PF
L7
R10 4.7K
C10 270
L9
R14 4.7K
C13 130
C14 330
R16 22
R18 47
R17 22
J2
40-41 MHZ OUTPUT
+12V
1
R15 47
L3 BEAD
C8 .047
L10 BEAD
C6 .0012
+V1
L1 BEAD
C2 .0012
+V2
-12V
1
R5 47
L11 BEAD
C15 .047
-V1
L2 BEAD
C19 .0012
-V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE

FUNCTIONAL SCHEMATIC DIAGRAM

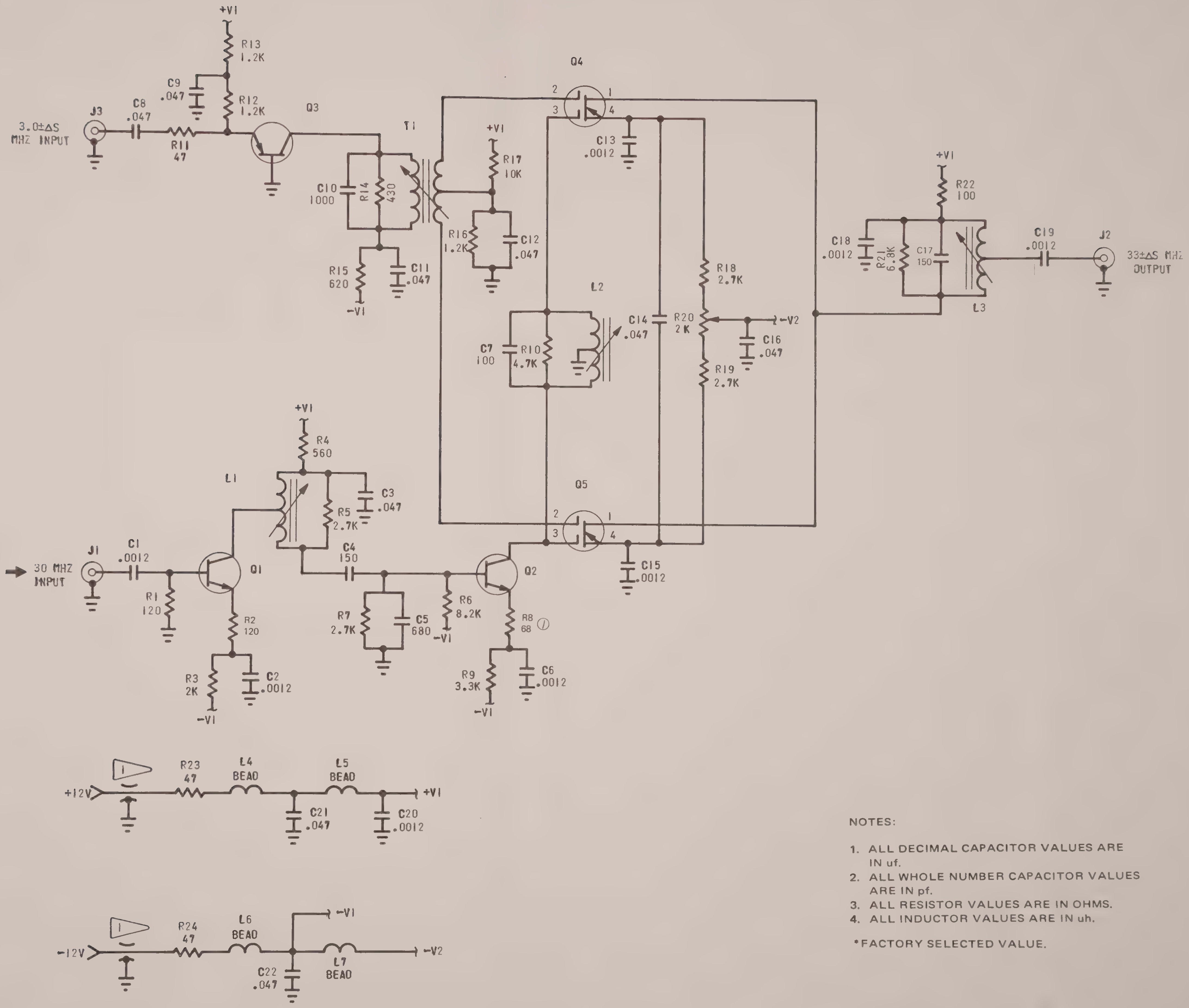
DIGIT ADDER MIXER FILTER
NO. 3 MODULE

Drawing No. 645-1143

REV.
b

58

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+V1
R13
1.2K
C9
.047
R12
1.2K
Q3
J3
C8
.047
3.0±ΔS
MHZ INPUT
R11
47
T1
C10
1000
R14
430
R15
620
-V1
C11
.047
+V1
R17
10K
R16
1.2K
C12
.047
Q4
2
1
3
4
C13
.0012
L2
C7
100
R10
4.7K
C14
.047
R20
2K
R18
2.7K
R19
2.7K
-V2
C16
.047
+V1
R22
100
C18
.0012
R21
6.8K
C17
150
L3
C19
.0012
J2
33±ΔS MHZ
OUTPUT
+V1
R4
560
L1
C3
.047
R5
2.7K
Q5
2
1
3
4
C15
.0012
J1
30 MHZ
INPUT
C1
.0012
Q1
R1
120
R2
120
R3
2K
C2
.0012
-V1
C4
150
R7
2.7K
C5
680
R6
8.2K
-V1
Q2
R8
68
①
R9
3.3K
C6
.0012
-V1
+12V
R23
47
L4
BEAD
L5
BEAD
+V1
C21
.047
C20
.0012
-12V
R24
47
L6
BEAD
-V1
C22
.047
L7
BEAD
-V2

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

CHANGES

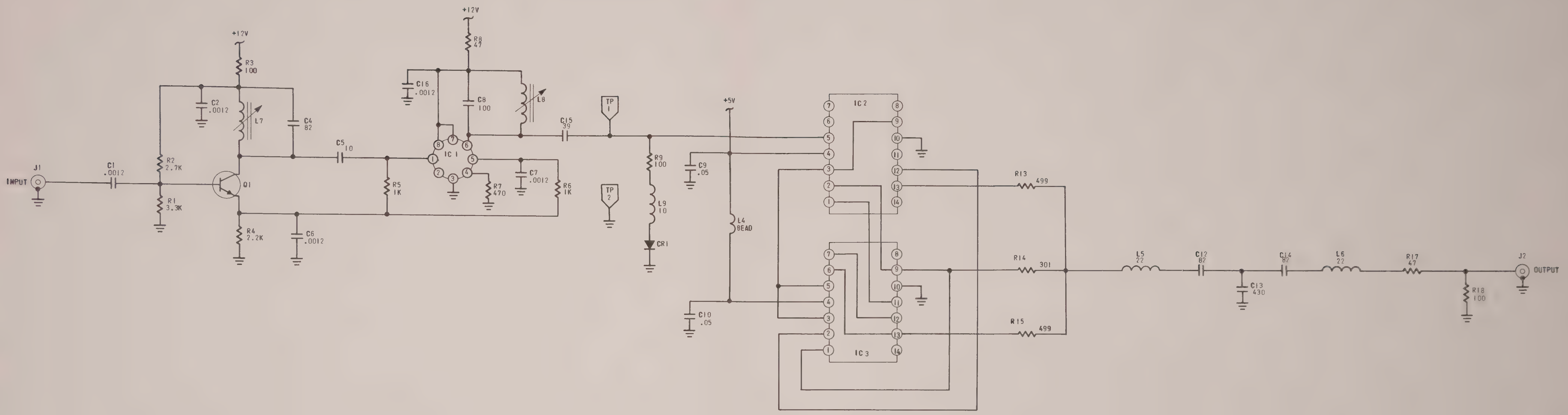
① FOR S/N 123 THRU 128: R2 WAS 56Ω
R8 WAS 47Ω

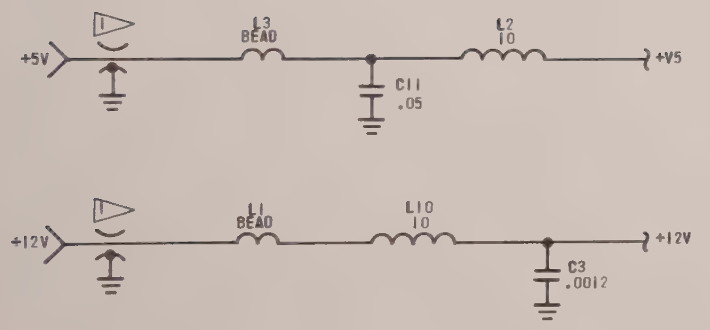
FUNCTIONAL SCHEMATIC DIAGRAM

SEARCH MIXER MODULE

Drawing No. 645-1146	REV. C

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


+12V
R3 100
C2 .0012
L7
C4 82
J1
INPUT
C1 .0012
R2 2.7K
R1 3.3K
Q1
R4 2.2K
C6 .0012
C5 10
R5 1K
+12V
R8 47
C16 .0012
C8 100
L8
IC 1
C7 .0012
R7 470
R6 1K
C15 39
TP 1
TP 2
R9 100
L9 10
CR1
+5V
C9 .05
L4 BEAD
C10 .05
IC2
IC3
R13 499
R14 301
R15 499
L5 22
C12 82
C13 430
C14 82
L6 22
R17 47
R18 100
J2
OUTPUT


+5V
1
L3 BEAD
C11 .05
L2 10
+V5
+12V
1
L1 BEAD
L10 10
C3 .0012
+12V

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

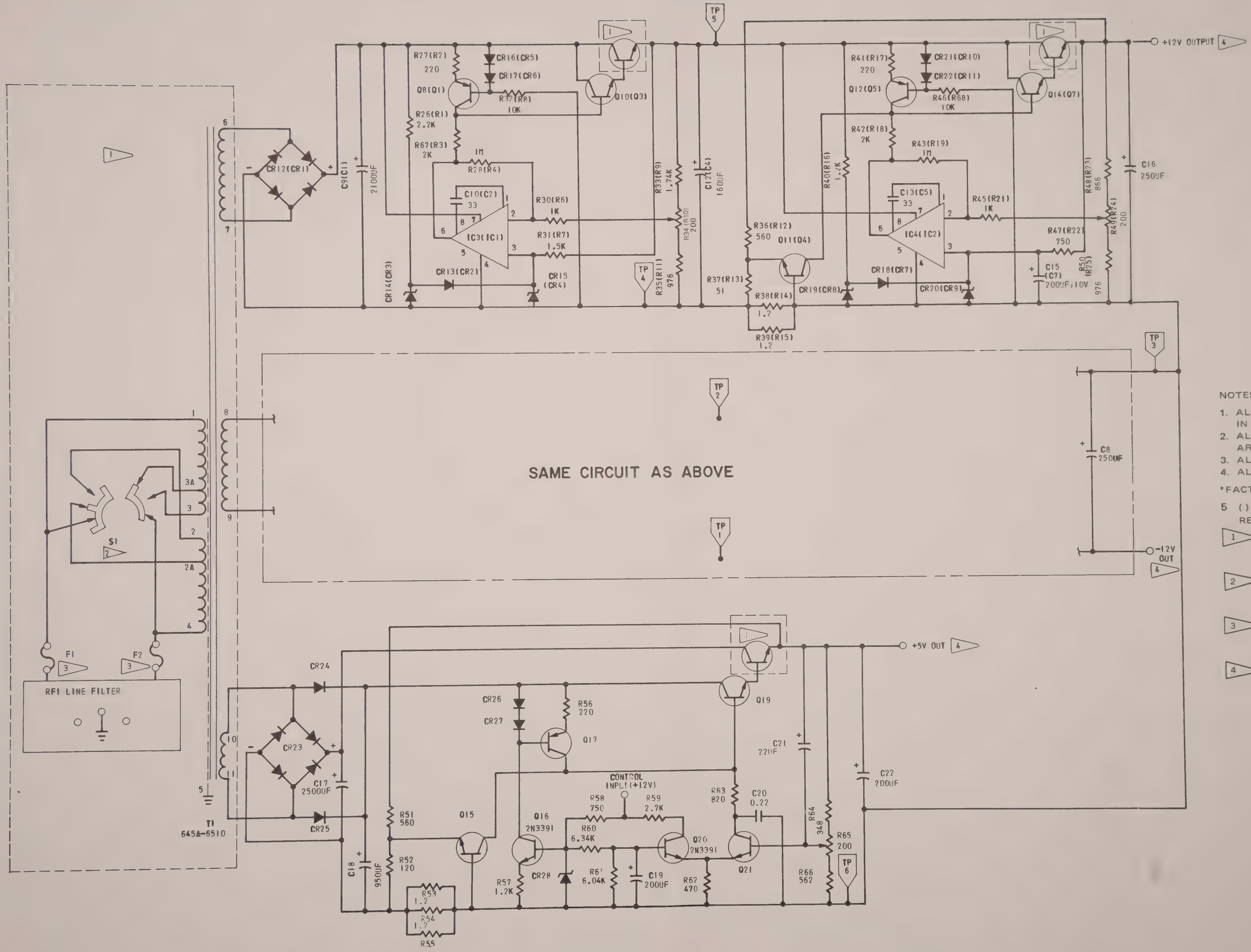
FUNCTIONAL SCHEMATIC DIAGRAM

10/1 DIVIDER NO. 2 MODULE

60

Drawing No. 645-1149 REV b

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


TP 5
+12V OUTPUT 4
R27(R2) 220
CR16(CR5)
CR17(CR6)
Q8(Q1)
R32(R8) 10K
Q10(Q3)
R26(R1) 2.2K
R67(R3) 2K
1M R28(R4)
CR12(CR1)
C9(C1)
2100UF
C10(C2) 33
R30(R6) 1K
IC3(IC1)
R31(R7) 1.5K
R33(R9) 1.74K
R34(R10) 200
C12(C4) 160UF
CR14(CR3)
CR13(CR2)
CR15 (CR4)
TP 4
R35(R11) 976
R41(R17) 220
CR21(CR10)
CR22(CR11)
Q12(Q5)
R46(R68) 10K
Q14(Q7)
R42(R18) 2K
R43(R19) 1M
R40(R16) 1.2K
C13(C5) 33
R45(R21) 1K
IC4(IC2)
R48(R23) 866
R49(R24) 200
C16 250UF
R36(R12) 560
Q11(Q4)
R47(R22) 750
C15 (C7) 200UF,10V
R50 (R25) 976
R37(R13) 51
R38(R14) 1.2
CR18(CR7)
CR19(CR8)
CR20(CR9)
R39(R15) 1.2
TP 3
TP 2
SAME CIRCUIT AS ABOVE
C8 250UF
TP 1
-12V OUT 4
1
3A
3
2
2A
4
8
9
6
7
S1 2
F1 3
F2 3
RFI LINE FILTER
5
T1 645A-6510
+5V OUT 4
CR24
CR26
CR27
R56 220
Q17
Q19
CR23
10
11
C17 2500UF
CR25
C21 22UF
C22 200UF
CONTROL INPUT(+12V)
R58 750
R59 2.7K
R63 820
C20 0.22
R51 560
Q15
Q16 2N3391
R60 6.34K
Q20 2N3391
Q21
R64 348
R65 200
C18 950UF
R52 120
R53 1.2
R54 1.2
R55
R57 1.2K
CR28
R61 6.04K
C19 200UF
R62 470
R66 562
TP 6

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

5. ( ) NUMBERS ENCLOSED IN PARENTHESES ARE REFERENCED DESIGNATIONS FOR -12V SUPPLY.

1 COMPONENTS ENCLOSED IN DASHED LINES ARE MOUNTED ON REAR PANEL OF INSTRUMENT.

2 S1-100/115/200/230 VAC LINE VOLTAGE SELECTOR SWITCH SHOWN IN 100V POSITION (FULL CCW)

3 FOR 100 AND 115VAC OPERATION USE [illegible]A SLO-BLO FUSE. FOR 200 AND 230VAC OPERATION USE 1A SLO-BLOW FUSE.

4 POWER SUPPLY OUTPUTS TIE TO TB-1 FOR DISTRIBUTION THROUGH INSTRUMENT.

FUNCTIONAL SCHEMATIC DIAGRAM

POWER SUPPLY

Drawing No. 645-1163

REV b

61

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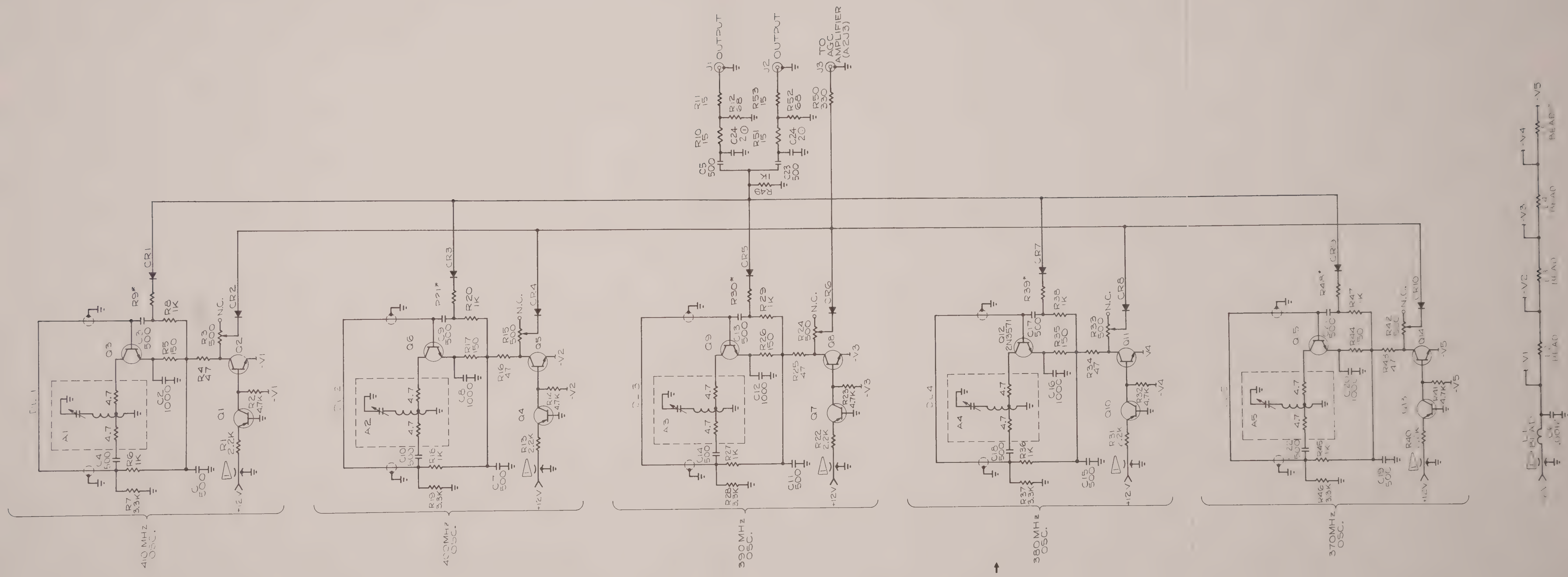
J1 OUTPUT
J2 OUTPUT
J3 TO AGC AMPLIFIER (A2J3)
410 MHz OSC.
400MHz OSC.
390MHz OSC.
380MHz OSC.
370MHz OSC.

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 ▷ 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM	
OSCILLATOR MODULE	
Drawing No. 645-1185	REV C
FLUKE JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133	

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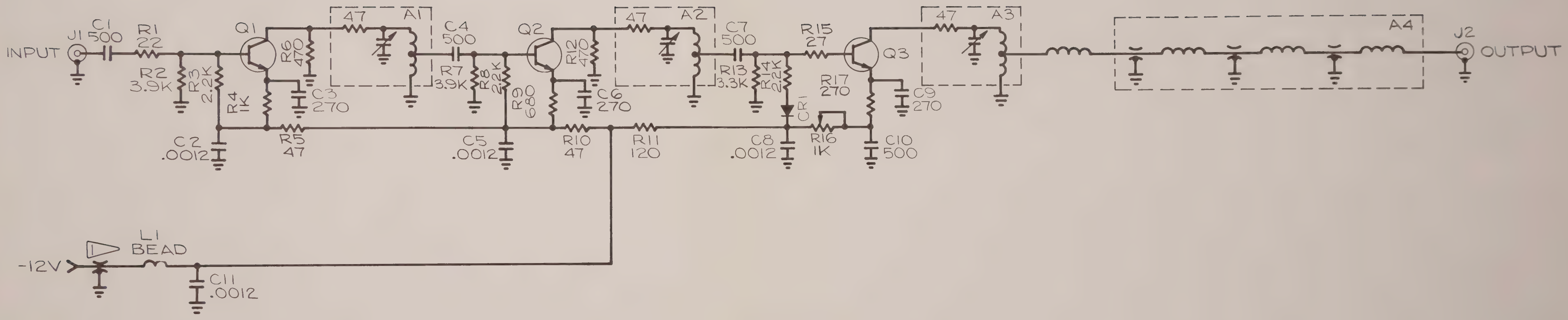
INPUT
J1
C1 500
R1 22
R2 3.9K
R3 2.2K
R4 1K
Q1
R6 470
C3 270
R5 47
C2 .0012
47
A1
C4 500
R7 3.9K
R8 2.2K
R9 680
C5 .0012
Q2
R12 470
C6 270
R10 47
R11 120
47
A2
C7 500
R13 3.3K
R14 2.2K
CR1
C8 .0012
R15 27
R17 270
R16 1K
Q3
C9 270
C10 500
47
A3
A4
J2
OUTPUT
-12V
①
L1 BEAD
C11 .0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

CHANGES

① FOR S/N 123 THRU 149: C1, C4, C7, C10 WERE 0.005μF.

FUNCTIONAL SCHEMATIC DIAGRAM

390, 380 MHz 3 STAGE AMPLIFIER MODULES

Drawing No. 645-1186, 1195

REV C

FLUKE **JOHN FLUKE MFG. CO., INC.**
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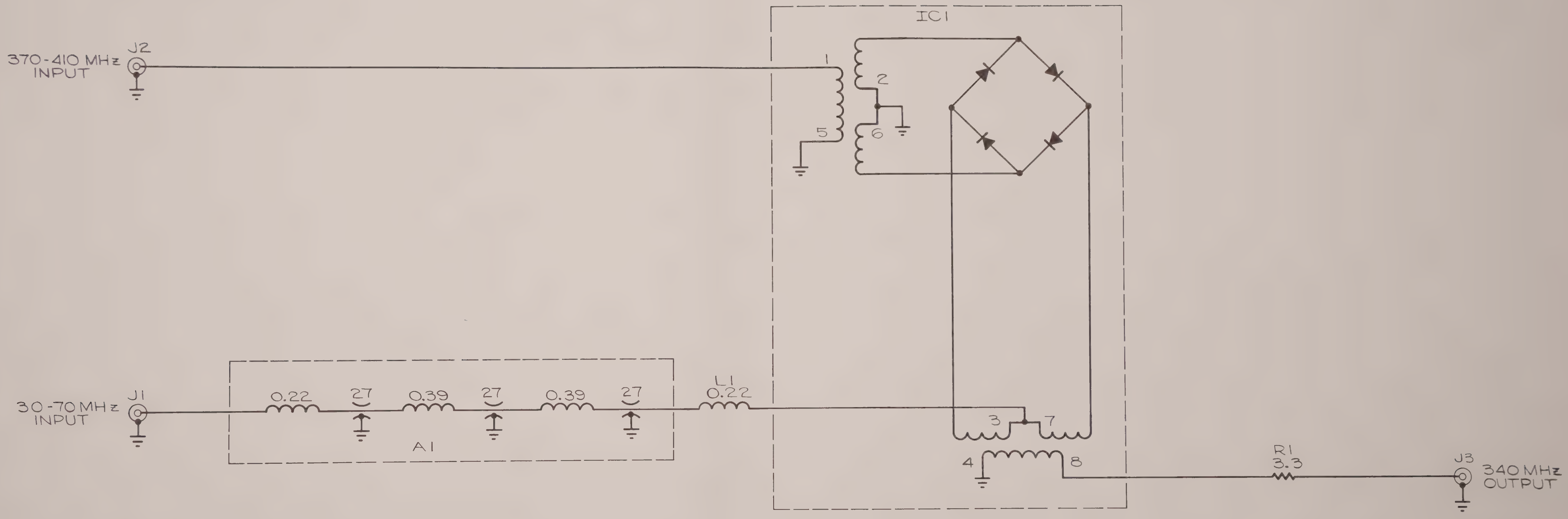
370-410 MHz
INPUT
J2
IC1
1
2
5
6
30-70 MHz
INPUT
J1
0.22
27
0.39
27
0.39
27
A1
L1
0.22
3
7
4
8
R1
3.3
J3
340 MHz
OUTPUT

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

INPUT MIXER MODULE

Drawing No. 645-1187

REV
b

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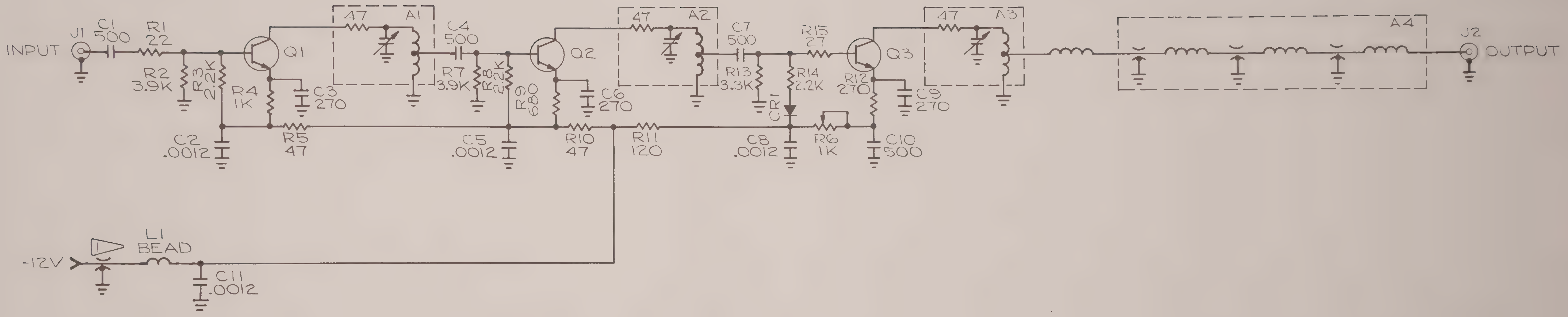
INPUT
J1
C1
500
R1
22
R2
3.9K
R3
2.2K
Q1
R4
1K
C3
270
C2
.0012
R5
47
47
A1
C4
500
R7
3.9K
R8
2.2K
R9
680
Q2
C6
270
C5
.0012
R10
47
R11
120
47
A2
C7
500
R13
3.3K
R15
27
R14
2.2K
CR1
C8
.0012
R6
1K
Q3
R12
270
C9
270
C10
500
47
A3
A4
J2
OUTPUT
-12V
L1
BEAD
C11
.0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

340, 415 MHz 3 STAGE
AMPLIFIER MODULES

Drawing No. 645-1188, 1196

REV
C

FLUKE JOHN FLUKE MFG. CO., INC.
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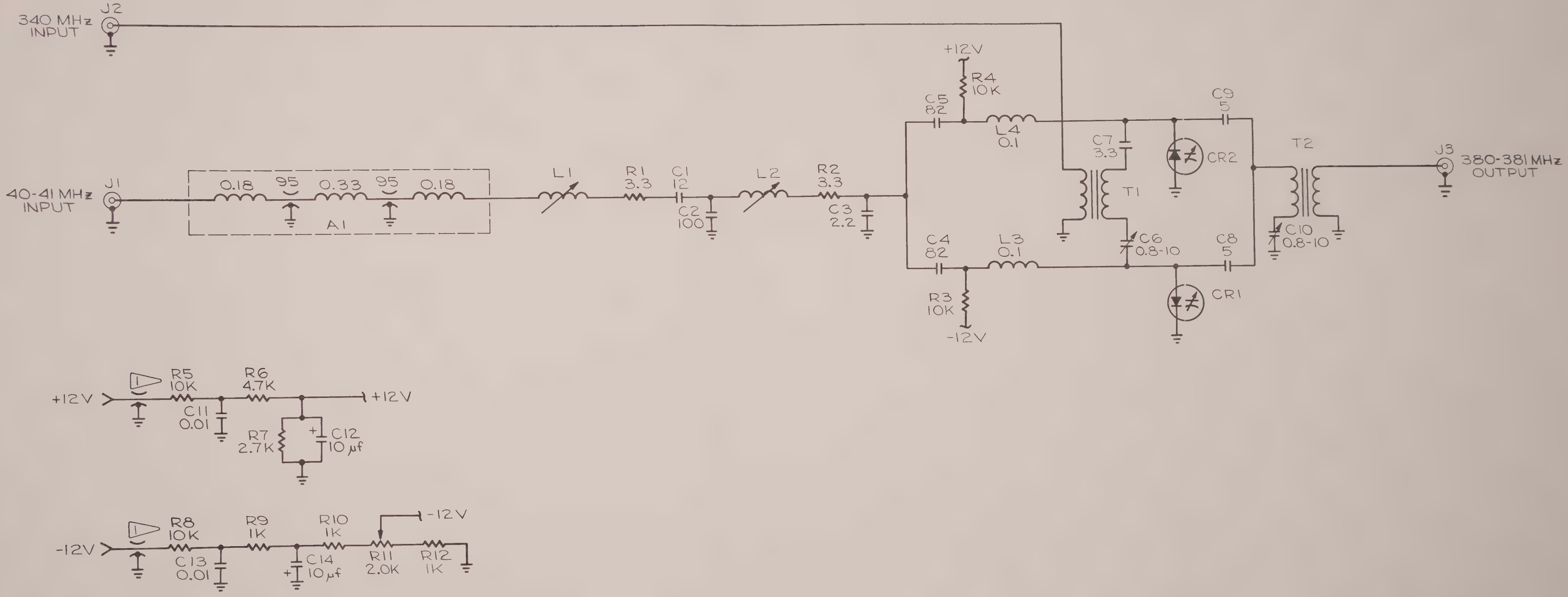
340 MHz INPUT
J2
40-41 MHz INPUT
J1
0.18
95
0.33
95
0.18
A1
L1
R1 3.3
C1 12
C2 100
L2
R2 3.3
C3 2.2
+12V
R4 10K
C5 82
L4 0.1
C4 82
L3 0.1
R3 10K
-12V
C7 3.3
T1
C6 0.8-10
CR2
CR1
C9 5
C8 5
T2
C10 0.8-10
J3
380-381 MHz OUTPUT
+12V
1
R5 10K
R6 4.7K
+12V
C11 0.01
R7 2.7K
C12 10 μf
-12V
1
R8 10K
R9 1K
R10 1K
-12V
C13 0.01
C14 10 μf
R11 2.0K
R12 1K

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

•FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

FIRST UP CONVERTER MODULE

Drawing No. 645-1189 REV b

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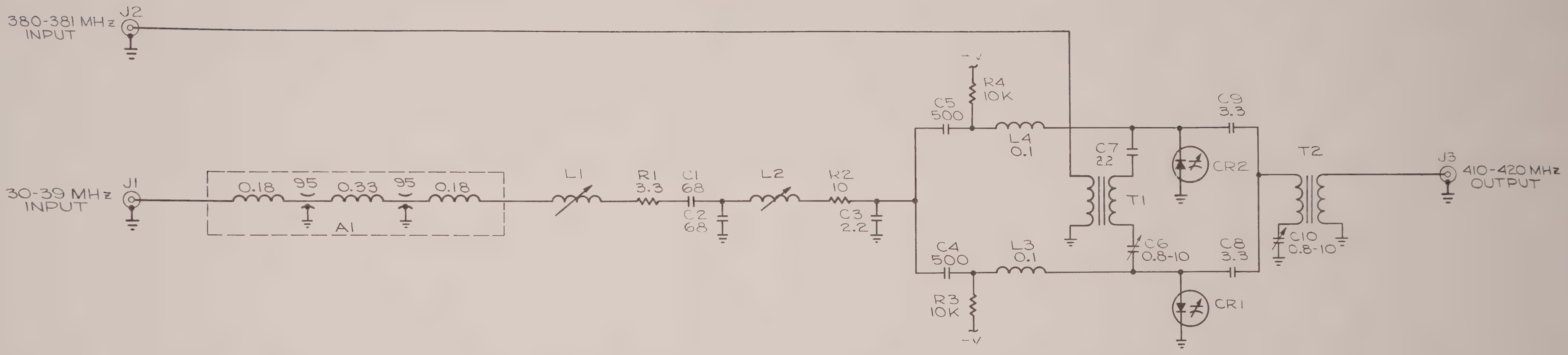
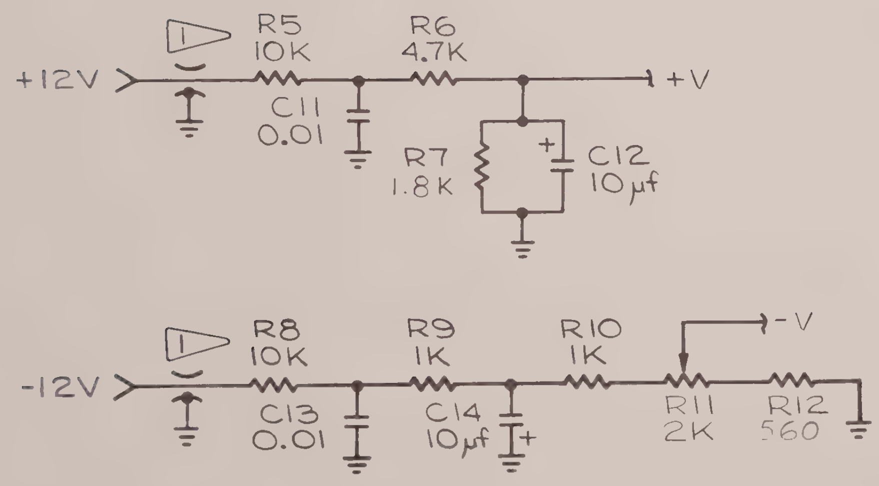

380-381 MHz INPUT
J2
30-39 MHz INPUT
J1
0.18
95
0.33
95
0.18
A1
L1
R1 3.3
C1 68
C2 68
L2
R2 10
C3 2.2
-V
R4 10K
C5 500
L4 0.1
C7 2.2
C9 3.3
CR2
T1
T2
J3
410-420 MHz OUTPUT
C4 500
L3 0.1
C6 0.8-10
C8 3.3
C10 0.8-10
R3 10K
-V
CR1


+12V
1
R5 10K
R6 4.7K
+V
C11 0.01
R7 1.8K
C12 10μf
-12V
1
R8 10K
R9 1K
R10 1K
-V
C13 0.01
C14 10μf
R11 2K
R12 560

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

•FACTORY SELECTED VALUE.

CHANGES

① FOR S/N 123 THRU 136: R7 WAS 2.7K R12 WAS 1K.

② FOR S/N 123 THRU 149: C4 and C5 WERE 0.005μF.

FUNCTIONAL SCHEMATIC DIAGRAM

SECOND UP CONVERTER MODULE

Drawing No. 645-1190

REV. C

FLUKE JOHN FLUKE MFG. CO., INC.
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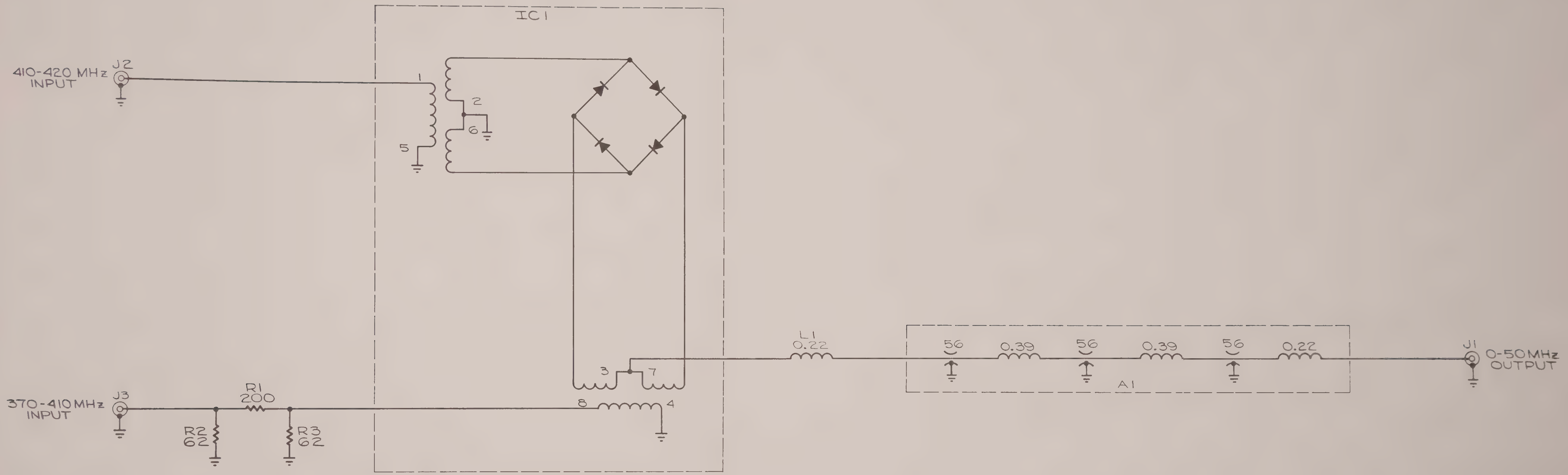
IC1
410-420 MHz INPUT
J2
1
2
6
5
3
7
8
4
L1 0.22
56
0.39
56
0.39
56
0.22
A1
J1
0-50MHz OUTPUT
370-410 MHz INPUT
J3
R1 200
R2 62
R3 62

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

OUTPUT MIXER MODULE

Drawing No. 645-1191

REV
b

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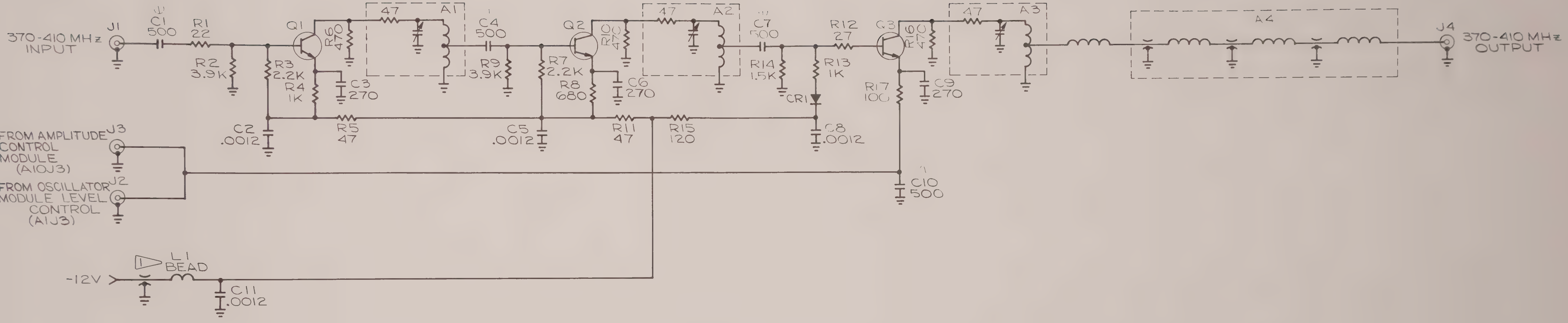
FLUKE
JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


370-410 MHz INPUT
J1
C1 500
R1 22
R2 3.9K
R3 2.2K
R4 1K
C2 .0012
Q1
R6 470
C3 270
R5 47
47
A1
C4 500
R9 3.9K
R7 2.2K
R8 680
C5 .0012
Q2
R10 470
C6 270
R11 47
47
A2
C7 500
R14 1.5K
R13 1K
CR1
C8 .0012
R15 120
R12 27
Q3
R16 470
R17 100
C9 270
C10 500
47
A3
A4
J4
370-410 MHz OUTPUT
FROM AMPLITUDE CONTROL MODULE (A10J3)
J3
FROM OSCILLATOR MODULE LEVEL CONTROL (A1J3)
J2
-12V
L1 BEAD
C11 .0012

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

*FACTORY SELECTED VALUE.

CHANGES

① FOR S/N 123 THRU 149: C1, C4, C7, C10 WERE 0.005μF.

FUNCTIONAL SCHEMATIC DIAGRAM

AGC AMPLIFIER MODULE

Drawing No. 645-1192

REV C

FLUKE JOHN FLUKE MFG. CO., INC.
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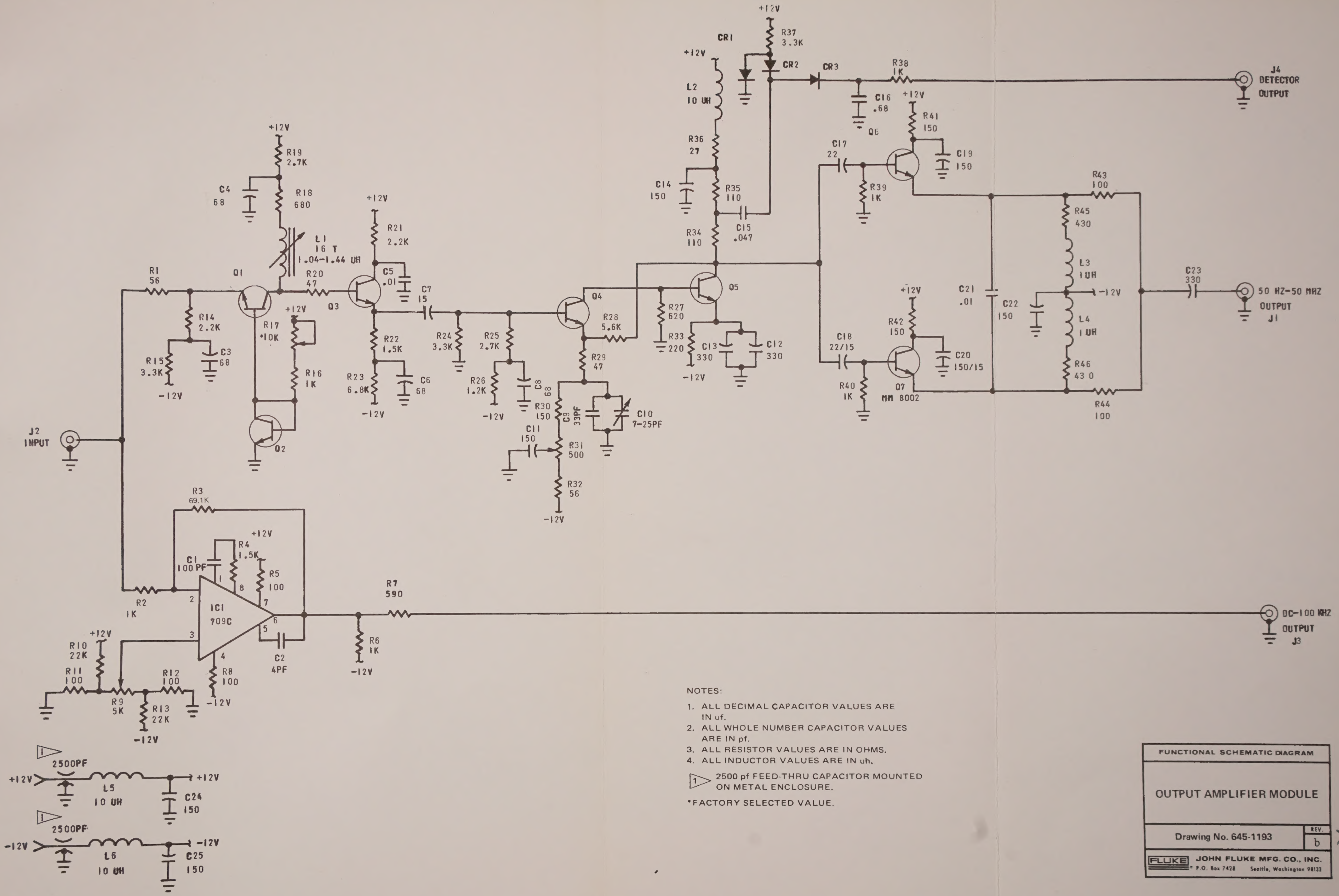
J2 INPUT
R1 56
Q1
R14 2.2K
R15 3.3K
-12V
C3 68
R17 *10K
+12V
R16 1K
Q2
+12V
R19 2.7K
C4 68
R18 680
L1 16 T 1.04-1.44 UH
R20 47
Q3
+12V
R21 2.2K
C5 .01
C7 15
R22 1.5K
R23 6.8K
-12V
C6 68
R24 3.3K
R25 2.7K
R26 1.2K
-12V
C8 68
Q4
R28 5.6K
R29 47
R30 150
C9 33PF
C10 7-25PF
C11 150
R31 500
R32 56
-12V
+12V
L2 10 UH
R36 27
C14 150
R35 110
C15 .047
R34 110
R27 620
R33 220
Q5
C13 330
C12 330
-12V
CR1
+12V
R37 3.3K
CR2
CR3
R38 1K
C16 .68
Q6
+12V
R41 150
C17 22
R39 1K
C19 150
R43 100
R45 430
L3 1 UH
-12V
L4 1 UH
R46 43 0
R44 100
C21 .01
C22 150
+12V
R42 150
C18 22/15
C20 150/15
R40 1K
Q7 MM 8002
C23 330
J4 DETECTOR OUTPUT
50 HZ-50 MHZ OUTPUT J1
R3 69.1K
C1 100 PF
R4 1.5K
+12V
R5 100
R2 1K
IC1 709C
1
8
7
2
3
4
5
6
C2 4PF
R8 100
-12V
R7 590
R6 1K
-12V
DC-100 KHZ OUTPUT J3
+12V
R10 22K
R11 100
R9 5K
R12 100
R13 22K
-12V
1
2500PF
+12V
L5 10 UH
C24 150
+12V
1
2500PF
-12V
L6 10 UH
C25 150
-12V

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

▷1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM

OUTPUT AMPLIFIER MODULE

Drawing No. 645-1193 REV. b

70

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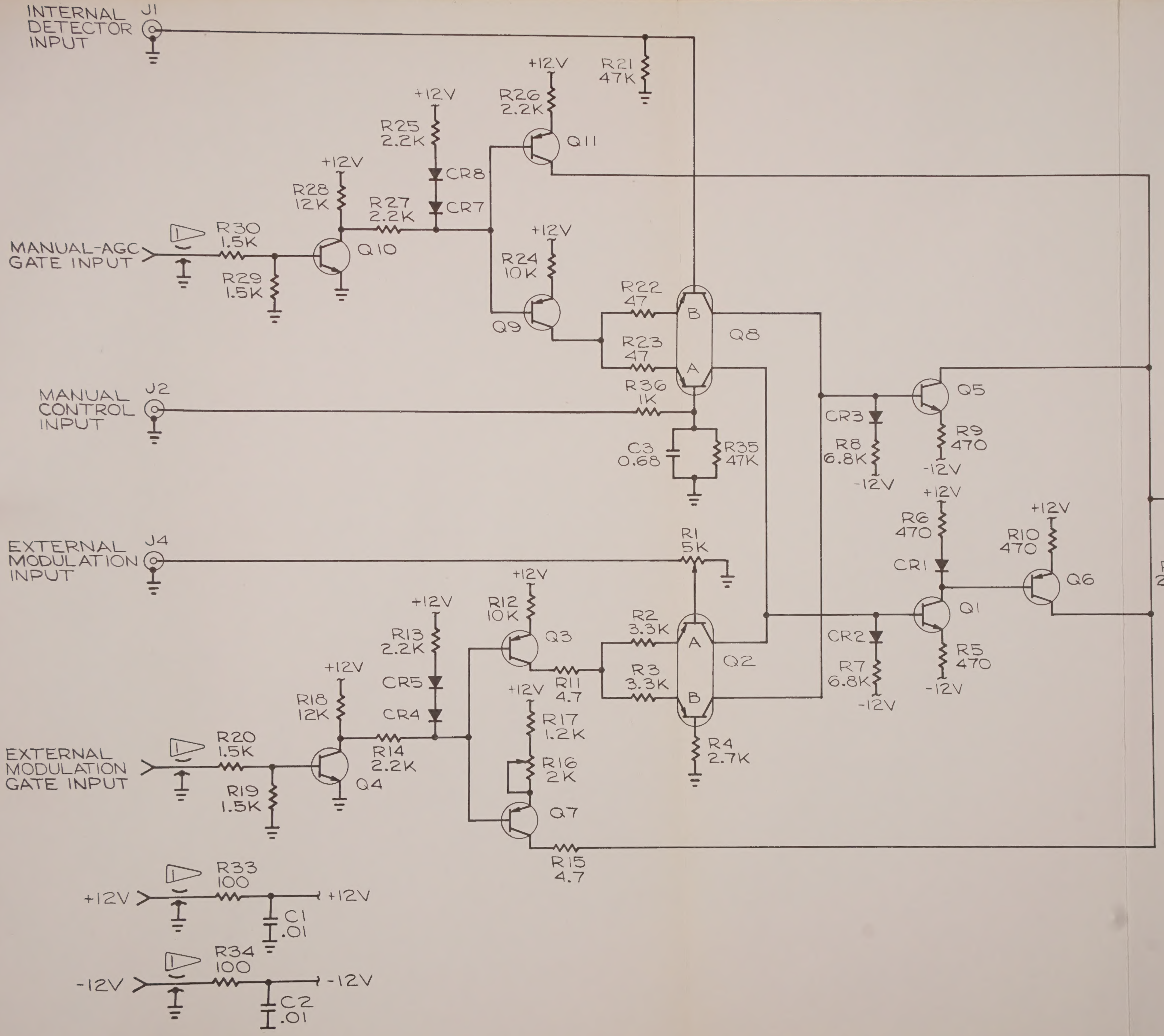
INTERNAL DETECTOR INPUT
J1
+12V
R21 47K
R26 2.2K
+12V
R25 2.2K
Q11
CR8
CR7
+12V
R28 12K
R27 2.2K
MANUAL-AGC GATE INPUT
1
R30 1.5K
Q10
R29 1.5K
+12V
R24 10K
R22 47
Q9
B
R23 47
Q8
A
MANUAL CONTROL INPUT
J2
R36 1K
C3 0.68
R35 47K
Q5
CR3
R9 470
R8 6.8K
-12V
-12V
+12V
R6 470
CR1
+12V
R10 470
Q6
Q1
EXTERNAL MODULATION INPUT
J4
R1 5K
+12V
+12V
R12 10K
Q3
R13 2.2K
R2 3.3K
A
CR2
R5 470
R7 6.8K
-12V
-12V
Q2
+12V
CR5
R11 4.7
R3 3.3K
B
R18 12K
CR4
+12V
R17 1.2K
R4 2.7K
EXTERNAL MODULATION GATE INPUT
1
R20 1.5K
R14 2.2K
R16 2K
Q4
R19 1.5K
Q7
R15 4.7
J3
AGC OUTPUT
CR6
R32 2.2K
R31 2.2K
-12V
+12V
1
R33 100
+12V
C1 .01
-12V
1
R34 100
-12V
C2 .01

NOTES:

1. ALL DECIMAL CAPACITOR VALUES ARE IN uf.
2. ALL WHOLE NUMBER CAPACITOR VALUES ARE IN pf.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. ALL INDUCTOR VALUES ARE IN uh.

1 2500 pf FEED-THRU CAPACITOR MOUNTED ON METAL ENCLOSURE.

*FACTORY SELECTED VALUE.

FUNCTIONAL SCHEMATIC DIAGRAM	
AMPLITUDE CONTROL MODULE	
Drawing No. 645-1194	REV. b
FLUKE JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133	